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Research Article

Environmental Monitoring Programme of Tasra Coal Project Chasnala, Dhanbad

B.K. Sinha¹ G. Kumar² & S.K. Singh²

¹ Ex GM, SAIL Chasnalla Coal Complex, Chasnalla, Dhanbad - India

² BIT Sindri, Dhanbad – 828 123 (Jharkhand) India

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Abstract: The Chasnalla block within the Jharia Basin is specially important for the coal mining activities. Consequence of mining activities involving drilling, blasting, crushing, transportation of coal etc. are the major concern for environmental pollution in the area. Mining and associated activities affect air, noise and water environment & degrades land and drainage system of the area. Therefore, its environment monitoring has become a necessity for the conservation of the environment. Environmental monitoring programmer involves (i) planning a survey and sampling program for systematic collection of data/information relevant to environmental assessment and project environmental management; (ii) conduct of the survey and sampling program; (iii) analysis of samples and data/information collected, and interpretation of data and information; and (iv) preparation of reports to support environmental management. Environmental Monitoring Programmer has been prepared for the Tasra Open Cast Project for assessing the efficacy of implementation of Environment Management Plan and to take corrective measures in case of any degradation in the surrounding environment. Different activities involved in the proposed opencast coal mining project, and their impact on various environmental attributes have been taken in to account while designing a detailed environmental monitoring programmer for the project.

Keywords: Drilling, Blasting, Crushing, Environmental monitoring programmer; environmental assessment; environmental impacts; predicted impacts

INTRODUCTIONa

Chasnalla Block lies in the South Eastern extremity of Jharia Coalfield (JCF) in the Dhanbad district of Jharkhand state. It covers an area of 4.5 Km². The area is roughly defined by north latitudes 23°38'25'' and 23°40'00'' and East longitudes 86°27'12'' & 86°29'15''. It is included in the survey of India Topo sheet no.73 I/6 and in Sheet No.8 of the geological map of JCF. **Figure 1** shows the regional location of the area. This Block is located about 15 km from Jharia town and about 23 km from Dhanbad town. Dhanbad - Sindri Road passes through its northern boundary.

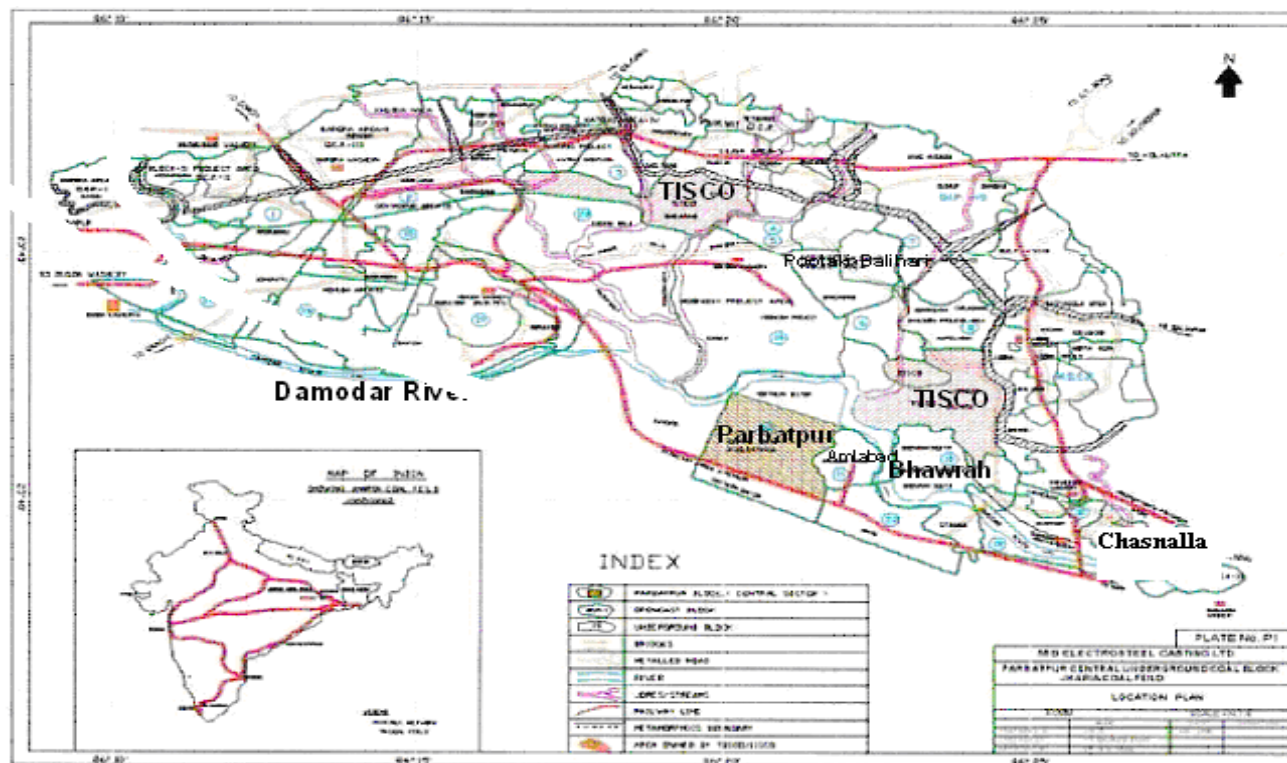


Fig. 1: Location Map of the Jharia Coalfield and Chasnalla Block.

Environmental monitoring should have clear objectives, and the survey and sampling program should be custom-designed to focus on data/information actually required to meet the objectives, Singh 2005. The monitoring program should include action or emergency plans so that appropriate action can be taken in the event of adverse monitoring results or trends. Environmental monitoring should also be constantly reviewed to make sure that it is effective, Daniel *et al.*¹. Lanzen *et al.*² & Mayes, *et al.*³. The following activities have been identified in the proposed Tasra Open cast Project, which will have significant environmental impacts:

- i. Construction activities of the project will result in dust generation.
- ii. During operational phase, coal handling arrangements at the surface and coal transport are the major source of air pollution.

- iii. Pumping of mine seepage water during the course of mining operations may have impact on surrounding ground water regime. Also, mine discharge water may contain coal fines and silt which contaminate the surface water, if let out without any treatment.
- iv. Wastewater from workshops generated due to vehicle washing and maintenance of machinery contain oil & grease, silt.
- v. Pit-head coal handling arrangements & vehicular movement will contribute to undesirable noise.

Keeping the above environmental impacts in view, an environmental management plan has been prepared for the project incorporating various mitigation measures for prevention/control of pollution, Fernandez⁴, Peché & Rodriguez,⁵. The monitoring methodology for studying the effectiveness of implementation of mitigation measures has been described hereunder.

METHODOLOGY OF MONITORING MECHANISM

Implementation of EMP and periodic monitoring is proposed to be carried out at (a) project level and (b) area level for Tasra Project and allied activities like coal handling facilities, workshop, mining colony, etc. Project level environmental protection measures like subsidence monitoring & management, dust suppression, treatment and recycling of waste water, plantation, and noise control in mine premises, housekeeping, implementation of EMP and Environmental Clearance conditions will be monitored by the project authorities. On the other hand, implementation of area level protection measures like plantation and green belt development over the vacant areas, colony effluent treatment, environmental quality monitoring etc., will be taken up by different disciplines of the company like Civil, Forestry and Environment Departments etc. Co-ordination between various disciplines and periodic monitoring of various environment protection measures will be done by a Senior Executive who reports directly to the area General Manager. He will be assisted by an environmental officer who is well versed with various aspects of pollution prevention and control in mining areas.

An environment management committee will be constituted at the project level consisting of following members to monitor the implementation of EMP and other environmental protection measures.

- a) Project Officer/Agent
- b) Mine Manager
- c) Safety officer
- d) Project survey officer
- e) Area Environmental officer
- f) Area Forestry officer
- g) Area Civil Engineer
- h) Hydro-geologist

In addition to the above Corporate Environment department will periodically inspect the project for monitoring the implementation of EMP and environmental status of the project surroundings and

necessary guidelines will be given to the project authorities in case of any deviation in compliance of clearance conditions.

POST PROJECT MONITORING PLAN

Air Quality Monitoring: Air quality monitoring is essential for evaluation of the effectiveness of abatement programmers and develops appropriate control measures. A preliminary field survey will be conducted to collect information on sources of air pollution, topography, population distribution, meteorological conditions etc., for establishing a network of stations in core and buffer zone of the project for ambient air quality monitoring. Ministry of Environment and Forests (MOEF) has stipulated environmental standards for coalmines vide GSR-742 (E), dt. 25.09.2000. As per MoEF guidelines, the concentration of Suspended Particulate Matter (SPM), repairable Particulate Matter (RPM), Sulphur dioxide (SO₂) and Oxides of Nitrogen (NO_x) will be monitored in downwind direction, at 500 m from the dust generating sources.

Frequency of monitoring: MOEF has stipulated load based frequency for monitoring of ambient air quality in coal mining areas as given below.

- i. Air quality monitoring will be carried out at a frequency of once in a fortnight (24 hourly sampling) at the identified locations near the dust generating sources.
- ii. As a result of monthly monitoring, if it is found that the concentration of the pollutants is less than the 50% of the specified standards for three consecutive months, then the sampling frequency may be shifted to two days in a quarter year.
- iii. In case the value has exceeded the specified standards, the air quality sampling shall be done twice in a week. If the results of four consecutive weeks indicate that the concentration of pollutants is within the specified standards, then fortnightly monitoring may be reverted to.

Methodology: Reparable dust sampler with gaseous sampling attachment will be used for sampling of air for SPM, RPM, SO₂ and NO_x for a period of 24 hours duration. Sampling and analysis will be carried out as per IS-5182:1999, Indian Standards for measurement of air pollution. SPM and RPM will be analyzed gravimetrically, SO₂ will be analyzed by Improved West and Gaeke method and NO_x will be analyzed as per Jacob &Hochheiser Modified (Na-Aresnite) Method.

Standards: The air quality standards, APHA, AWWA, and WPCF, 1995⁶ prescribed by MOEF vide Notification No. GSR 742(E), Dt: 25.09.2000 for work zone of new coalmines are furnished hereunder in **Table 1**.

Annual arithmetic mean for the measurements taken in a Year has to be arrived out following the guidelines for frequency of sampling and annual arithmetic mean of 24- hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days. In case of any residential or commercial or industrial place falling within or beyond 500 m. of any dust generating sources, the National Ambient Air Quality Standards, EPA Notification: GSR 176 (E), April 02, 1996, will be made applicable⁶.

Table 1: Air Quality Standards for New Coal Mines

Category	Pollutant	Time weighted Average	Concentration in Ambient Air	Method of Measurement
New Coal Mines	Suspended Particulate Matter (SPM)	Annual Average* 24 hours**	360 $\mu\text{g}/\text{m}^3$ 500 $\mu\text{g}/\text{m}^3$	Repairable Particulate Matter Sampler
	Repairable Particulate Matter (size <10 μm) (RPM)	Annual Average* 24 hours**	180 $\mu\text{g}/\text{m}^3$ 250 $\mu\text{g}/\text{m}^3$	Repairable Particulate Matter Sampler
	Sulphur Dioxide (SO_2)	Annual Average* 24 hours**	80 $\mu\text{g}/\text{m}^3$ 120 $\mu\text{g}/\text{m}^3$	1. Improved west and Gaeke method 2. Ultraviolet fluorescence
	Oxide of Nitrogen as NO_x	Annual Average* 24 hours**	80 $\mu\text{g}/\text{m}^3$ 120 $\mu\text{g}/\text{m}^3$	1. Jacob & Hochheiser Modified (Na-Aresnic) Method 2. Gas phase Chemiluminescence

Water Quality Monitoring: Water quality monitoring involves periodical assessment of quality of mine discharge water, treated workshop effluents, treated colony effluents, ground water and surface water. The following parameters are to be periodically monitored in effluents in a coal mining industry as per the Environmental Standards for coalmines, GSR-742 (E), dt. 25.09.2000, APHA⁶ ; Armor & Willimson⁷.

Parameters:

- 1) pH
- 2) Total Suspended solids
- 3) Chemical Oxygen demand (COD)
- 4) Oil & Grease

All the parameters as given in Part-A of General Standards for Discharge of Environmental Pollutants, GSR 801 (E) EPA 1986 prescribed by CPCB must be analyzed for all the effluents, in addition to the above parameters, once in a year for assessing the overall quality of effluents. As pH, Total Suspended solids, Chemical Oxygen Demand (COD), Oil & Grease are the critical parameters identified for monitoring of effluents from coal mines, ground water quality and surface water quality of nearby water bodies will also be analyzed periodically to study the impact of mining operations.

Frequency of monitoring: Monitoring of water and waste water samples for four parameters shall be done at a frequency of once in a fortnight. Effluent water samples will be analyzed for all parameters as given in Part-A of General Standards for discharge of Environmental Pollutants, GSR 801 (E) EPA 1993, prescribed by CPCB, once in a year. Surface water samples will be analyzed for all the parameters as per

IS-2296 and ground water samples will also be analyzed for all the parameters as per IS-10500, once in a year.

METHODOLOGY

The sample collection, procedures for sample preservation and methods of analysis are followed as per Standard Methods of Water and Wastewater analysis, American Water Works Association (AWWA), American Public Health Association (APHA).

Standards: The standards prescribed by MOEF for effluent water samples are as follows:

- i. pH - 5.5 to 9.0
- ii. Chemical Oxygen Demand (COD) - 250 mg/l
- iii. Total Suspended Solids (TSS) - 100 mg/l,
- 200 mg/l (Land for irrigation)
- iv. Oil & Grease (O & G) - 10 mg/l

In addition to the above, the following standards will be followed for complete analysis of water samples, once in a year.

- 1) Industrial Effluents: GSR 801 (E), EPA, 1986, dated Dec. 31, 1993
- 2) Surface water : IS-2296-1982
- 3) Ground water : BIS 10500 : 1991

Noise Level Monitoring: Noise level monitoring is done for achieving the following objectives:

- i. To compare sound levels with the values specified in noise regulations
- ii. To determine the need and extent of noise control of various noise generating sources
- iii. Correlation of community noise levels with community response to noise

Noise level monitoring will be done at the work zone in opencast workings to assess the occupational noise exposure levels and also at the noise generating sources like coal handling arrangements, maintenance workshop, mine ventilation fan, nearby villages to assess the noise levels and their propagation for taking necessary control measures at the source.

Parameters: The noise level recordings are measured in dB (A) Leq values, where dB (A) denotes the time weighted average of the level of sound in decibels on scale A, which is relatable to human hearing.

Frequency of monitoring: Monitoring frequency for noise levels shall be once in a fortnight. MOEF has stipulated that noise levels have to be monitored between 6.00 AM to 10.00PM for daytime and 10.00AM to 6.00PM for nighttime.

Methodology and Instrumentation: Precision integrated noise level meters will be used for monitoring of Leq noise levels in dB (A) scale at the work place and also in the surrounding villages.

Standards: (i) MOEF has stipulated noise level standards for coalmines as follows:

Time duration	6.00 A.M. - 10.00 P.M	10.00 P.M. - 6.00 A.M
Noise Level	Leq 75 dB(A)	Leq 70 dB(A)

MOEF has also stipulated ambient air quality standards in respect of noise in Noise Pollution (Regulation and Control) Rules, 2000 as shown in **Table 2**. MOEF stipulated in GSR-742 (E), dt. 25.09.2000 that occupational exposure levels of noise as prescribed by DGMS should also be followed at work environment.

Table 2: Ambient Air Quality Standards in Respect of Noise (MOEF)

Area Code	Category of Area/Zone	Limits in dB(A) Leq *	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

DGMS stipulated, vide circular no 18 of 1975, the following standards for attainment in work environment:

- A warning limit of 85 dB (A) is set below which there will be little risk to an unprotected ear for an eight hour exposure.
- The danger limit value of 90 dB (A) , above which hearing impairment and deafness may result from an unprotected ear.
- A worker should not be allowed to enter, without appropriate ear protection, an area in which the noise level is 115 dB (A) or more.
- Personal protective equipment shall be worn, if here are single isolated outbursts of noise which can go above 130 dB(A) “impulse” or 120 dB(A) “Fast”
- No worker shall be allowed to enter an area where the noise level exceeds 140 dB(A)

Monitoring of Phreatic Surface Levels: Phreatic surface levels will be monitored throughout the life of the project by a Hydro-geologist to study the impact of mining operations on ground water regime. A network of observation wells will be identified for monitoring of phreatic surface levels, Singh *et al.*⁸; Singh *et al.*⁹ The trend of ground water level fluctuations will be monitored by recording of phreatic surface levels during pre-monsoon and post-monsoon seasons, Kumar *et al.*¹⁰ and Kumar *et al.*¹¹. The summarized Post Project Environmental Monitoring Programmer of the project is given hereunder in **Table 3**.

Monitoring of Emergency Procedures: The Mine Manager monitors the emergencies that may occur in mining operations and prepares an emergency plan to deal with mine fires, inundation etc. The emergency plan provide for mock rehearsals at regular intervals. Manager submits the copy of the emergency plan to regional inspector of mines safety for approval. The emergencies that will be regularly monitored are

spontaneous heating & fires, damage to surface structures due to subsidence, inundation of workings.

Monitoring of Mine Closure Plan: The monitoring of the mine closure plan is an essential requirement for review of the efficacy of the mine closure plan and to take corrective actions. The monitoring consists of measuring the Air quality, Water Quality, preservation of landscape, aesthetic and other land use values as prescribed in the mine closure plan. Area level environment management committee will monitor the implementation of mine closure plan.

Table- 3: Post Project Environmental Monitoring Programmer

Parameter to be monitored	Proposed location	Monitoring		Remarks
		Sampling duration	Frequency	
Ambient Air Quality				
SPM, RSPM, SO ₂ and NO _x	One station in the project site and at least three in nearby residential, commercial or industrial areas – one in the upwind and two stations on the downwind directions.	24 hours	Twice a week/fortnight/ two times in a quarter year depending on the pollution load.	Respirable dust sampler
Noise	3 stations – one station in project site and two in the nearby villages.	24 hours	Once in fortnight	Sound level meter
Water samples	Samples from the mine discharge, workshop effluents, nearby water bodies and ground water samples from the nearby villages		Once in fortnight for the critical 4 parameters as specified in GSR 742(E) and one sample every year for all the optional parameters as given in GSR 801(E). IS-2296-1982 for Surface water and BIS 10500: 1991 for ground water.	
Phreatic surface level	Different observation wells around the project site	One time	Pre- and Post- monsoon	Manually
Meteorological Parameters	One station in the mining area	24 hours	Continuous	Weather monitoring station

REPORTING SCHEDULES OF MONITORED DATA

The monitored data on air quality, water quality, noise levels studies and phreatic surface levels will be periodically examined by the Project Level Environment Management Committee for taking necessary corrective measures. The post-project data will be submitted to JPPCB in consent renewal applications, environmental statements every year and to MOEF in half-yearly monitoring reports. The work zone air quality data, noise levels, will also be submitted to DGMS at periodical intervals.

BUDGET PROVISION FOR EMP IMPLEMENTATION & MONITORING

The feasibility report of Tasra Open Cast Project includes a full financial assessment of the cost of development of the mine and its operation. Sufficient fund allocation has been made towards

environmental management and monitoring by way of direct capital. A number of other environmental control and management items are also included in in-direct cost under various other capital heads.

In order to implement the environmental protection measures, an amount of Rs. 278.66 lakhs is provided in capital cost as given in **Table 4**. A recurring cost of Rs. 54.74 lakhs per annum will also be spent on environmental management as given in **Table 5** which works out to Rs. 2.53 per tone of coal produced. This expenditure is in-built in the cost of production.

Table 4: Capital Cost for Environmental Protection Measures

SN	Item	No. of persons	Cost per unit	Total Capital (Lakhs)	Phasing in years						
					PS-1	1	2	3	4	5	6
A	Rehabilitation and Re-settlement										
	1. No. of persons to be rehabilitated	23007									
	2. Compensation for the above		1.65	193.66				193.66			
B	Pollution abatement facilities			10.00				5.00	5.00		
C	Effluent treatment plant			20.00			10.00	10.00			
D	Subsistence allowance			0.00							
E	Compensatory Afforestation			0.00							
F	Env. Baseline data generation and EMP preparation, etc.			15.00	15.00						
G	Green belt development around fan house, CHP, service buildings, etc.			20.00			5.00	5.00	5.00	5.0	
H	Pollution and monitoring equipment /scientific studies			10.00			10.00				
	Total			278.66	15.00	0.00	30.00	218.66	10.0	5.0	0.0

Table 5: Revenue cost towards environmental management

<i>S. N.</i>	Description	Total Cost Rupees	Cost per Tone Rupees
1.	Wages	1457343	0.67
2.	Stores	703054	0.33
3.	Power	108000	0.05
4.	Gen. Administration & Misc. Expenses	145734	0.07
5.	Post Project EMP	1500000	1.69
6.	Interest on working capital	68497	0.03
7.	Interest on loan Capital	98188	0.05
8.	Depreciation	1393300	0.65
	Total	54,74,118	2.53

CONCLUSIONS

The following activities have been identified in the proposed Tasra Open cast Project, which will have significant environmental impacts:

- Construction activities of the project will result in dust generation.
- During operational phase, coal handling arrangements at the surface and coal transport are only the major source of air pollution.
- Pumping of mine seepage water during the course of mining operations may have impact on surrounding ground water regime. Also, mine discharge water may contain coal fines and silt which contaminate the surface water, if let out without any treatment.
- Wastewater from workshops generated due to vehicle washing and maintenance of machinery contain oil & grease, silt.
- Pit-head coal handling arrangements & vehicular movement will contribute to undesirable noise.

Keeping the above environmental impacts in view, an environmental management plan has been prepared for the project incorporating various mitigation measures for prevention/control of pollution. The monitoring methodology include:

- Air Quality Monitoring
- Water Quality Monitoring
- Noise Level Monitoring
- Monitoring of Phreatic Surface
- Monitoring of Mine Closure Plan

In order to implement the environmental protection measures the works out cost is only Rs. 2.53 per tone of coal produced. This expenditure is in-built in the cost of production

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*** Corresponding author: Prof. (Dr.) G. Kumar**

Professor & Head, Department of Geology,
B.I.T. Sindri, P.O. Sindri Institute, Dhanbad – 828 123 (Jharkhand)