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Environmental Impact of Roadway Coal Transportation in Coal Mining Areas – A Case Study

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Abstract: Power generation in India has increased from 1362 MW in 1947 to about 105,000 MWs as on March 2002 out of which about 62,000 MWs is from coal based power stations. Over 100,000 MWs additional generation capacity needs to be added by 2012 to bridge the gap between demand and supply of power. Coal would continue to be the prime source of energy in India in foreseeable future. The coal demand is stated to grow from over 512 mt in 2003 – 04 to 557 mt in 2006 – 07 and 712 mt in 2011-12. Use of coal brings own share of problems. The impact of coal mining on environment and ecology can be extensive over surface, hydroshere and biosphere with surface mining while it would be limited in case of underground mining.

Land system around coal mining areas experiences significant impact due to coal mining and coal transportation. In coal mining areas, coal mines and coal based industries are situated at distant places. Due to increasing trend in coal production per year and in order to cater the need of coal washeries, coke oven plants and other coal based industries, heavy increases in transportation of coal is recorded through roadways from the loading point. As a consequence, this particular area is affected by all types of environmental pollution such as noise, dust and water pollution.

Main problem encountered with coal transportation is spilling of coal fragments from the heavy vehicles and their subsequent crushing. The pulverized coal particles sometimes become air borne. Some of these powdered coal particles are being taken into nearby drainage system and agricultural fields. Since almost all roads in the district, whether urban or rural are being utilized for coal transportation, the ecological impact is very severe.

In the present paper an attempt has been made to discuss the status of coal transportation pollution in the Dhanbad – Jharia mining area (within the district of Dhanbad, Jharkhand) and also to suggest mitigation measures.

Keywords: *Hydrosphere, Biosphere, Underground Mining, Washeries, Spilling.*

I. INTRODUCTION

Coal is the main source of commercial energy in India and accounts for nearly 2/3rd of its total commercial requirements. The known reserves of coal in India at present are around 204 billion tones out of which nearly 35 % are in the proved category. Coal industry in India is over 200 years old but the growth in Indian Coal Industry took place since 1971. The coal production at the present time is nearly 500 MT per annum. This enormous exploitation figure consists of an exact coordination of Three M's, i.e.

1. Manpower
2. Machinery &
3. Management

Out of these three, management has a very significant role considering the fact that the utilization of the coal is never at the same place from where the coal has been mined. In coal mining areas, coal mines and coal based industries are situated at distant places. Due to increasing trend in coal production per year and in order to cater the need of coal washeries, coke oven plants and other coal based industries, the coals are to be transported to a large distance. Though there are several modes of coal transportation, viz. through water ways, trolley ways, conveyor system for a short distance, underground transport system and road transportation. But in our country the main mode of coal transportation is recorded through roadways from the loading point. As a consequence, this particular area is affected by all types of environmental pollution such as noise, dust and water pollution.

II. MODE OF COAL RAISING & COAL TRANSPORT

There are two modes of Coal transportation:

First Set : Through Roadways. This mode is also known as the discontinuous transportation system.
Second Set : Through Conveyors, Railways, Ferries. This mode of transportation is known as the continuous transportation system.
The present study is based on the impact of the coal transportation through road ways,. i.e. the First set or the discontinues transportation system.

III. ROAD TRANSPORTATION IMPACT

The main supply system of the coal to the coal based industries in India is still the road ways, though in other developed countries, the underground transportation system and ferry transportation systems are widely used. However, in our country, coal transportation by road will remain consistent for many more years. But the road conditions in the coalfield are far from satisfactory. Jharia coal field in Jharkhand is one of the most important coal field of India, providing about 30 % of the total Indian production of coal. This is situated in the Dhanbad district of Jharkhand and about about 250 kms NW of Kolkata in the heart of the Damodar valley. It is the largest, oldest and the only source of prime coking coal in India. In the vicinity of this coal field, almost all types of environmental pollutions are observed because of mining, industrial and commercial activities. These activities involve large scale transportation of coal through road.

Nearly one lac tonne of coal and 25,000 tonne of sand are transported daily to and from this coal field. This includes transportation of R.O.M. coal to washeries, washed coal from washeries to steel and thermal power plants and hard coke and remaining coal to different parts of India. On the other hand, the transportation of materials towards the mines include stowing materials, machinery and other items.

The worst road conditions and heavy load of transportation in the coal mining areas are highly responsible for noise and dust pollution and subsequently surface and sub-surface water pollution. These aspects of pollution are discussed as follows :

IV. COAL TRANSPORTATION & NOISE POLLUTION

The development of society has led to more and more sound sources giving higher and higher noise levels. Coal raising or coal excavation from the mine sites followed by transportation to the desired sites involve so many machinery and equipments. In the coal excavation, continuous miner, shovel, drag line, bucket fill excavator, bucket chain excavator are extensively used. These sets of operations (2nd set) along with the coal transportation (1st set) create extensive noise pollution. The most serious effects of exposures to high noise levels is deafness which is initially temporary but with consistent effects it may become permanent. Though the noise pollution is not fatal to human life, yet its importance cannot be overlooked because repeated exposure to noise affects the productivity and efficiency. Noise pollution may cause both physiological & psychological effects as given below:

A. Physiological Effects of Noise Pollution

- Headache by dilating blood vessels of the brain
- Increase in the rate of heart beat
- Narrowing of arteries
- Fluctuations in the arterial blood pressure by increasing the level of cholesterol
- Impairment of night vision
- Decrease in the rate of colour perception
- Lowering of concentration and affect on memory
- Muscular strain and nervous breakdown

B. Psychological Effects of Noise Pollution

- Depression and fatigue
- Insomnia as a result of lack of undisturbed and refreshing sleep
- Stressing of senses and annoyance
- Affecting of psychomotor performance
- Emotional disturbance

So far the noise pollution is concerned, mining activities do not contribute much in this regard. Mine workers who are operating the mining equipment or work in the close vicinity thereof are liable to pollution caused by noise. Poor traffic scenario and road conditions are responsible for the high figure. The road vehicles are one of the major sources of ambient noise pollution. This noise is mainly generated by the engine, the horn and the frictional contact between the vehicle, ground and air. The level of traffic noise depends upon traffic flow rate, speed of vehicles, change in engine speed and power and the proportions of heavy vehicles on road, [1], [2].

V. METHODOLOGY

Measurement of noise was carried out by using Sound Level Meters. The sound level was monitored for 60 minutes in each of the four locations, i.e. industrial, Commercial, residential and silence zone areas during both day and night times. For each location atleast 05 readings were obtained, and the average value of these readings were taken for further discussions.

Respirable dust concentration was measured by using SIBATA digital dust counter. The apparatus is a quick dust counter with digital display and time. The device measures dust concentration on number basis, which is approximately equal to 1mg/m3 per 1000 counts per minute. The peak concentration of reparable dust just behind a moving dumper was measured for a period of 15 seconds. Beyond this time period, it was observed that the dust raised by moving dumper gets diluted quickly due to prevailing wind condition and humidity [3], [4].

Ground water in the vicinity of this roadways is chemically analysed by using Perkin Elmer – 2380 (AAS) for the trace and major element concentrations.

VI. NOISE LEVEL IN MINING AND INDUSTRIAL ENVIRONMENT

Coal transportation through road ways is an active agent of noise pollution. The regular movement of heavy vehicles to and fro at the loading point is a major point of concern [5]. The ill effects of noise pollution are in no way less harmful than those of water, soil and air pollution. In order to study the impact of noise pollution, systematic noise monitoring has been carried out at some of important mining and industrial areas and are given in Table 1. This table also indicates the ambient air quality standards in respect of noise as per the schedule – III of Rule 3 (1) of the environment (Protection) Rules, 1986 set by the Central Pollution Control Board (CPCB) [2].

In order to analyse the nature of noise produced by the movement of the vehicles, Ambient noise monitoring along the Dhanbad Jharia Mining areas and the traffic counts along this area are measured and are presented in Table 2.

VII. TRANSPORTATION & DUST POLLUTION

Dust is an accepted fact with almost every operation in the coal mines. Mechanization of transportation has increased generation and dissipation of coal in atmosphere significantly. This dust will easily get air borne during adverse condition [6]. About 1 lac tonne of coal and sand is transported daily from and to collieries of Jharia coal field area. Out of which coal transportation accounts for 80 % . Dust is an unwanted by product of all mining and industrial activities [7]. The main problem associated with coal transportation is spilling of coal fragments from the trucks and subsequent crushing by the vehicles [8]. The pulverized coal particles sometimes become air borne. Clouds of dust scavenging downwind is a common sight during vehicular movement in dry months. These mobile dust sources disappear soon after the vehicle movement is stopped. However, with increased frequency of traffic, the cloud may appear to be continuous causing delays and difficulties in most other activities.

The problem is compounded by the weight and speed of the vehicles plying on the roads. This dust is injurious to men, machinery, building, vegetation and water bodies besides its other known adverse effect on productivity. This also adds SPM load of the atmosphere. Some of these powdered coal particles are being taken to nearby drainage system and agricultural fields. On hardening, such dust materials cause problems to the germination of seeds of plants. The adverse effect of dust is the air-borne dust particles of all size may cause irritation of the eyes, ears, noise and also may result in skin irritation, discomfort and reduced visibility. Most of the toxic metals are associated with the respirable range of dust, which could penetrate the

respiratory tract and get deposited into the tissues and may lead to various respiratory diseases [9].

The extent of particulate pollution of atmosphere can be visualized from the fact that 01 cc of coal can form 1 x 1012 particles of 01 micron [10]. These fine particles falling under the influence of the gravitational force are resisted by viscous resistances of the air, and thus remain air borne for long time. Suspended dust particles in the air are inhaled and thereby reach the lungs or are spread over plants, vegetation and soil. The haul roads were reported to produce 0.25 to 0.70 kg of dust per kilometer travel of a dumper. Dumping of dry coals from the dumpers to the crusher sites also created cloud of dust. The concentration of dust fall and suggested particulate matters were reported to be increasing every year and has reached much above the threshold limit. The maximum and minimum dust concentration in the area of Jharia Coal field was reported to be of the order of 33.32 and 16.15 tons/sq km/month in 1986 [10], [11].

VIII. GROUND WATER POLLUTION ALONG THE JHARIA – DHANBAD ROAD DUE TO DUST IMPACT

Main cause of ground water pollution in the vicinity of the roadway through huge coal transportation is involved is the point source under the influence of the coal dust and causes groundwater contamination [4], [5], [6]. Some of the physico-chemical parameters of this ground water as compared to the standards are given in Table. 3.

IX. MITIGATIVE MEASURES OF DUST & NOISE POLLUTION

Acoustical barriers in the form of earthberms are effective in reducing noise pollution. Plantation of trees attenuates sound to the order of 100 dBA per 100m width from sound source. Plantation also controls air and dust pollution [10]. Besides these, we may also adopt certain measures as mentioned below to overcome dust and noise pollution. Besides these, alternative mode of coal transportation such as tunnel system of transportation, underground transport system with gate belt conveyor system, ferry system etc. should be adopted for causing minimum sound and dust pollution.

A. Dust Control

Dust control measures has reached to an alarming situation in the vicinity. This can be controlled by adopting the following strategies:

- Use of sharp teeth of bucket wheel excavator.
- Use of sharp drills for drilling blast holes.
- Modification in the design of hoppers at the transfer points.
- Regular water spraying on roads and other dirt areas.
- Plants such as Silver oak (Grevillia roberea), Eucalyptus (Eucalyptus sp) and Neem (Azadirachta indica), Sidha (Legerstromata paryiflora), Karanj (Pongamia pinnata), Mahua (Madhuca indica) & Sal (Shorea robusta) have the dust arresting capability and dust absorbing capacity respectively, hence these plants species should be grown.

B. Noise Control

Noise control is the technology for obtaining an acceptable noise environment at one or multiple receivers with economic and operational consideration [1]. The various techniques that could be applied for noise control can be classified as :

1. Control at source
2. Control at transmission path
3. Control at receiver by using some protective devices

These controls can be maintained as follows:

- Generators wherever used should have some acoustic hoods.
- Various machineries should not be allowed to generate more noise by proper designing, maintenance and providing partition.
- Proper maintenance of roads in the area.
- Restriction on the use of horns by vehicles passing through residential and silence zones.
- Plants such as Pipal (Ficus religiosia), Neem (Azadiirachta indica) and Sal (Shorea robusta) have the noise absorbing capacity, hence their plantation should be encouraged.

CONCLUSION

On account of the past legacies of unsystematic and unplanned mining activities in Jharia coalfield, dust pollution has become a major concern. Various other industrial activities in this area also add to the air pollution. Also road conditions in this coalfield area are proving to be a major factor towards accentuating the air and dust problem. This dust problem is a major cause for poor health conditions of the inhabitants and they suffer most for respiratory tract diseases.

On the other hand mining activities do not contribute much to noise pollution. The fact, however, stays that the mine workers who are operating the mining equipments or work in close vicinity thereof are liable to pollution caused by noise. Poor traffic scenario and road conditions are responsible for the high figure. The road vehicles are one of the major sources of ambient noise pollution. This noise is mainly generated from the engine, the horn and the frictional contact between vehicle, ground and air. The level of traffic noise in general depends upon traffic flow rate, speed of vehicles change in engine speed and power and the proportions of heavy vehicles on road [11]. The groundwater in this vicinity is not affected much because of this point source only, i.e. the dust impact [12]. However, if it is mixed with other sources of contamination such as diffuse sources or line sources, the water no longer remains potable and hence should be treated and disinfected prior to using.

Table 1: Noise Level in Mining and Industrial Environment of Dhanbad – Jharia Area

Location (Industry Wise) Underground Mine (Lodna Area)	**Noise Level (in dBA)**	**Location (Industry Wise) Opencast Mine (Kusunda Area)**	**Noise Level (in dBA)**
Compressor House	90	Project Office locality	72
WEF 6 Winder operator room	88	P & H Electric Shovel	92
Pit top locality	87	Feeder breaker / Crusher	93
Tippler	88	BEML Dumper i. Idling ii. Full acceleration	 92 105
Area Workshop Shed	89	Engineers office	78
Main exhaust fan operator room	99		
Coke Oven Plant (Loyabad)		**Coal Washery (Lodna)**	
Exhause Engine (200cu.m/hr)	87	Workshop	69
Single Roll primary Crusher	98	Motor room of cement Mill no. 4	98
Coke bench	72	Cement mill no. 1 & 2 (feeding position)	100
Office locality	68	Compressor (03 Nos.)	98
		Power Control room	72

Table 2: Ambient Noise Level of Dhanbad – Jharia Mining Area

Area Code	**Locality**	**Noise Level in dBA (Day Time)**		**Noise Level in dBA (Night Time)**	
		Measured Value	**Standard Value**	**Measured Value**	**Standard Value**
Industrial Area			**75**		**65**
Ind 1	Dhansar -Bastacola Industrial Area	84		72	
Ind 2	Jharia Industrial Area	82		78	
Commercial Area			**65**		**55**
Com 1	State Govt. Bus Stand	85		82	
Com 2	Bank More	75		60	
Com 3	Purana Bazar	76		58	
Com 4	Park Market, Hirapur	85		68	
Com 5	Station Road	68		57	
Com 5	Jharia Market	88		60	
Residential Area	CMRI Colony		**55**		**45**
Res 2	Railway Colony	65		58	
Res 3	DGMS Colony	68		57	
Res 3	Bus Stand Housing Colony	68		48	
Res 3	Koyla Nagar Colony	65		52	
Silence Zone			**50**		**40**
Sil 1	Central Hospital	66		59	
Sil 2	P.M.C. Hospital	72		62	

Table 3 : Quality of Ground Water in the Vicinity of Jharia – Dhanbad Road

Parameter	Measured Value	Standard
pH	8	6.8 – 8.5
Turbidity (NTU)	30	5 – 10
Dissolved Oxygen (ppm)	4	6
TDS	680	< 500
Pb (ppm)	0.2	0.1
F (ppm)	0.8	1.5
As (ppm)	0.5	0.05
Se (ppm)	0.5	0.05
Cr (ppm)	0.8	0.5
Cu (ppm)	2.5	3
Fe + Mn (ppm)	0.8	0.3
Mg (ppm)	200	125
Zn (ppm)	18	15
Cl (ppm)	500	250
SO_4 (ppm)	600	250
Phenol (ppm)	0.002	0.001
SiO_2 (ppm)	12	8
Total alkanity as ($CaCO_3$) (ppm)	580	440

References

[1] Chhatwal, P.F., Mehta, M. C. and Satake, K. 1989. Environmental Noise Pollution and its Control. Anmol Publication, New Delhi, pp - 260.

[2] CPCB (1991). Noise Level in Metropolitan Cities, Control of Urban Series. CPUS/ 35/ 1991, Part III – Kolkata.

[3] Curl, S.J. 1978. U/G Transport in Coal Mines, IEA Coal Research, London.

[4] Krishna Murari, Girijesh Kumar & Vikrama Pandey. 2016. Ground Water Recharge Potential of the Dhanbad Dist, Jhaerkhand – A Case Study, 2 (9), 2016. Int J of Science Tech & Engg. pp 29 – 37.

[5] Kumar, G., Dey, U.K., Murari, K & Singh, D.N.P. 2005. Water Conservation in Coal Mines – A Case Study. Int. Seminar on Mineral Processing Tech., Tata McGraw Hill, Delhi, ESBN 0–07-059921-1. Ed. R.Benugopal, T.Sharma, V.K.Saxena & N. R. Mandre.

[6] Kumar G , Singh SK 1 Murari K, Pandey V, Om Prakash, Sinha BK, Prasad SK. 2012. Quality Assessment and Recharge Potential of Ground Water of Chasnala Coal Mines – A Case Study. Res. J of Pharmaceutical, Biological & Chem.Sc, 3(1), 2012, pp - 647 – 652.

[7] Mitra, D.K. and Dhar, B.B. 1995. Investigations on Respiratory Diseases in Mining Environ, First World Mining Congress, N. Delhi, 1996, pp 990.

[8] Nair, P.K. and Singh, B. 1990. Haul road dust Consolidation in Open Cast Mines – A New Approach, Indian J Environmental Protection, Vol. 10., No. 1, pp – 62

[9] Northard, J.H. 1976. Transportation of Minerals and Manpower, Colliery Guardian, V – 224, No. 8, pp 6.

[10] Padmanabhamurty, B. 1996. Efficacy of Screens and Vegetation in Mitigating Vehicular Traffic Noise. IJEP, V 16, No. 2, pp 129 – 134.

[11] Pandya, G.H. 1997. Noise Scenario in Relation to Vehicular Traffic in the City of Nagpur, IJEP, V 17, No. 4, pp 241 – 245.

[12] Singh, T.N., 1987. Geo-Environment of Indian Coalfields. Sharda Prakashan, 1997, pp 131–133.