

Impact of Coal Mining on Ambient Air: A Case Study of Singrauli Coal Mines Area

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Abstract— Coal is a major source of energy in India for many decades and assumed to contribute to nearly 60% of India's energy requirement. Coal mining adversely affects the ecosystem as a whole but it is also a very cheap and abundant source of energy. Coal mining is basically associated with the extraction of coal mineral and resulting in degradation of natural resources like air, water, land and the destruction of habitat., thus poses a threat to biodiversity. A huge quantity of waste material is produced by several mining activities in the coal mining region. If proper care is not taken for waste control and disposal, mining activity degrades the surrounding environment. Thus this study is aimed to assess the impact of excessive coal mining on the environment and attempts to make a realistic examination of the environmental impact of mining operations on the ambient air parameters by coal siding and processing carried out in the singrauli Area Coal Field Region in the district of singrauli, Madhya Pradesh (India).

Keywords: Air Pollution, Coal Mining, Environment, Impacts, Nigahi, Jayant Amlori, Kakri, Khadia, Jhingurda, Pollution

ABBREVIATIONS

OCM- Opencast mine, SPM – Suspended particulate matter, PM- Particulate matter, SO₂- Sulphur Dioxide, NO₂- Nitrogen Dioxide

I. INTRODUCTION

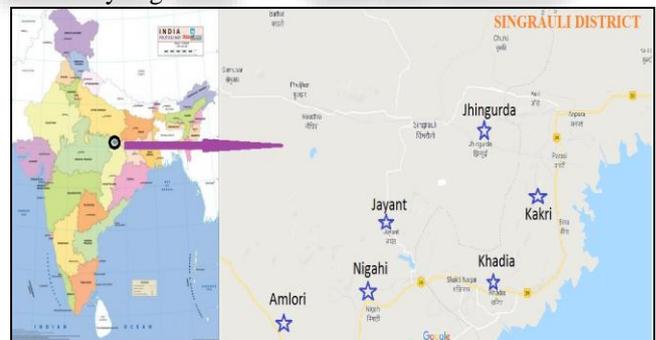
Coal is commonly called the black gold and it contributes a major part to production of energy for commercial and domestic need and hence it is widely used in the power industry to generate electricity. However, as compared to other fossil fuels, coal generates more pollution with less energy production efficiency. Mining activity results a tremendous pressure on surrounding flora and fauna, particularly where forest land is used for mining. Coal is the most abundant available fossil fuel around the globe which meets a major part of the conventional energy source needed for human consumption. Coal mining provides a huge energy source; but ultimately, this adversely affects the environment of the mining area by excavation and causes deforestation. The activities which are responsible for pollution around coal mining areas are drilling of mineral, blasting using explosives, loading and unloading of coal and overburden, dust from hauling roads and transport roads, exposed overburden dumps in open areas, coal handling plants, exposed faces of pits, presence of fire in coal mineral, exhausts and dust from heavy machineries, crushing of coal to a desired size in the feeder breakers. Coal mining is a very leading industry. But, it leads to fatal injuries and chronic health problems among miners, such as black lung disease, asthma, and various other diseases which causes permanent

scarring of the lung and its tissues. In addition, the miners and the communities near these mines are also adversely affected through mining operations like blasting, the dispersal of dust from coal transporting, open pits and collapse of abandoned mines. Environmental effects of coal mining are potentially very broad which creates air, soil, noise, water pollution and loss of biota. Hence, the environmental impacts of coal mining sites must be assessed periodically with in fixed time interval for air quality assessment.

II. MATERIALS AND METHODS

A. Study Area

Singrauli area consists of north east part of Singrauli district of Madhya Pradesh & southern part of Sonebhadra district of Uttar Pradesh. It is the 50th district of Madhya Pradesh which is disintegrated from Sidhi district on 24th May 2008. It is an emerging power hub of India due to availability of coal & water. N.C.L has ten working open cast coal mines which produced 70.021 million tonnes of coal during 2012-2013. N.C.L. has planned to reach 80 million tonnes by the year 2016-2017. Water Rihand dam has reservoir capacity of 129 million cubic meter & catchment are 5148km². Dam & spill way. Dam height is 91meter & length 934meter. Because of these two factor that is availability of coal and water. Electricity is generated in the minimum cost.



Power Generating capacity of India is 211766.22 MW that is 100%, out of which 141713.6 MW that is 66.91% from thermal, 121610.88MW that 57.42% from coal based thermal power plant, 13732 MW from singrauli approximately 12 % of coal based thermal power plant. Near about 10000 MW under construction. Due to this much of power Generation in singrauli Lot of Air pollution occurs in the singrauli the main pollution content are SO₂, NO_x, PM₁₀(RPM) & PM_{2.5} which are in very high Quantity and their chances to exceed beyond allowable limit.

For air quality monitoring, SIX number of monitoring colliery sites were selected. These collieries are Nigahi OC mine, Jayant OC mine, Amlori OC mine, Kakri OC mine, Khadia OC mine, Jhingurda OC mine were selected in different directions and distances in coal mining area of Singrauli coal mining area.

S. No.	Colliery	Cat.	Site Name
1.	Nigahi O/C Mine	A	Manager Office
		B	Nigahi colony Entrance
		B	Nigahi Market
2.	Jayant O/C Mine	A	Manager Office
		B	Jayant Gol Market
3.	Amlori O/C Mine	A	Manager Office
		B	Near Colony Dispensary
4.	Kakri O/C Mine	A	Manager Office
		A	Excavation Office
		B	Kakri Main Gate
5.	Khadia O/C Mine	A	Manager Office
		B	Near Civil Office
6.	Jhingurda O/C Mine	A	Near Manager Office
		B	Jhingurda colony

Table 1: The characterization of monitoring sites is detailed in Table

Cat. - A- Industrial, B-Residential

B. Methods of Monitoring for particulate and gaseous pollutants:

The air quality monitoring for SPM, PM_{2.5}, PM₁₀, SO₂ and NO₂ was done at different study sites i.e. near coal mine siding as well as residential areas. The gaseous pollutants were analysed through wet chemistry method as prescribed by Indian Standard Code (IS). Various methods used for monitoring is described below:

1) SO_x:

The test sample is collected using portable gas samplers (impingers) once at each site for continuous eight hours. To determine the SO₂ concentration in ambient air, sample was collected in gas sampler by drawing air at flow rate of 1.1 L/min through absorbing solution of 0.1 N sodium tetramercurate in High Volume Sampler (IS 5182 PART 2:2001). A di-chloro-sulphito-mercurate complex solution is thus formed and then reacted with sulphamic acid, pararosaniline and formaldehyde, to form coloured pararosaniline methyl-sulphonic acid. The absorbance of the solution was measured at 560 nm using UV-VIS spectrophotometer. The results are shown below:

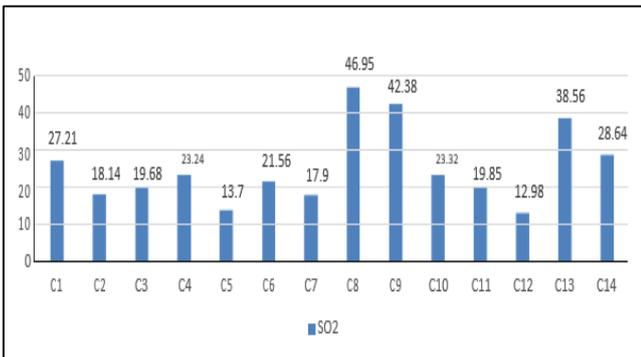


Fig. 2: Sulphur Di-Oxide (SO₂) (µg/m³) 24 hrs.

2) NO₂:

For NO₂, sample was collected in air sampler. air was drawn at same flow rate through a mixture of 0.4% sodium

hydroxide (NaOH) and 0.1% sodium arsenite (NaAsO₂-) (IS 5182 PART 6:2006). The concentration of nitrite ion (NO₂-) produced during sampling is determined calorimetrically by reacting the nitrite ion with phosphoric acid, sulfanilamide, and N-(1-naphthyl) - ethylene di-amine di-hydrochloride (NEDA) and measuring the absorbance of highly coloured azodye at 540 nm using a UV-VIS spectrophotometer, the results are as under:

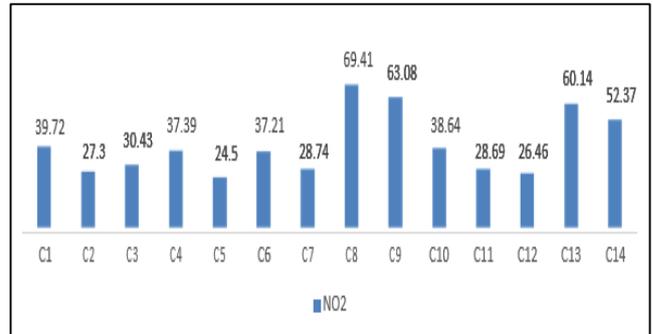


Fig. 3: Nitrogen Di-Oxide (NO₂) (µg/m³) 24 hrs.

3) SPM:

The SPM was collected for continuous eight hour at a flow rate of 1.1 m³/min through Whatman-glass fibre filter of standard dimension of 20.4 cm × 25.4 cm using a high volume sampler (IS 5182 PART 4:2005). The difference of initial weight of filter before and after final weight after sampling was used to calculate PM₁₀, Same was done for PM_{2.5}. concentration and SPM concentration was calculated by adding the concentration of particulate collected through hopper of high volume sampler (IS 5182 PART 23:2006, CPCB Vol-1 2013).

PM₁₀ and PM_{2.5} of various sites are as under:

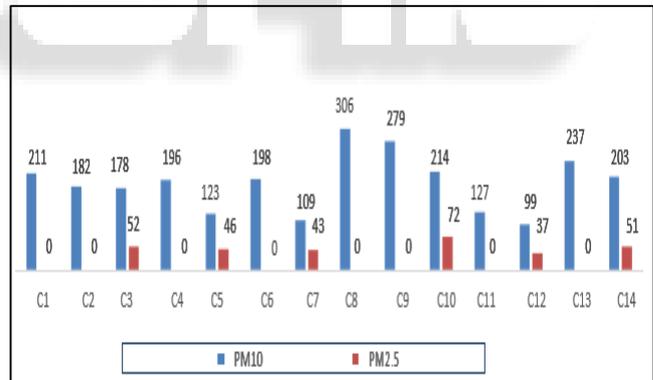


Fig. 4: Particulate Matter (PM₁₀ AND PM_{2.5}) (µg/m³) 24 hrs. SPM of various sites are as under:

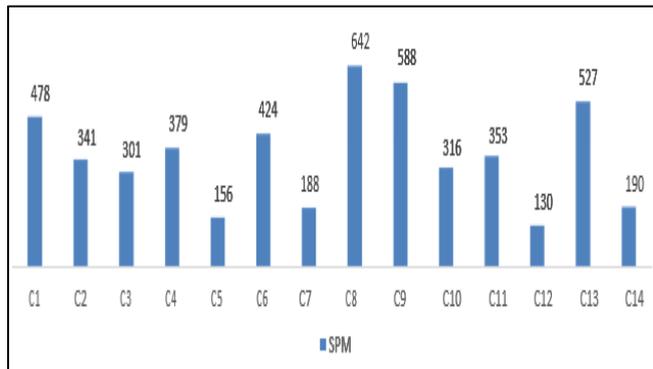


Fig. 5: Suspended Particulate Matter (µg/m³) 24 hrs.

III. RESULTS AND DISCUSSION

PARAMETER				SPM	PM ₁₀	PM _{2.5}	SO ₂	NO ₂
LIMIT (µg/m ³) 24 hrs.	CATEGORY	INDUSTRIAL-A		600	300	-	120	120
		RESIDENTIAL-B		200	250	60	80	80
METHOD OF ANALYSIS				IS 5182 PART 4:2005	IS 5182 PART 23:2006	CPCB Vol-1 2013	IS 5182 PART 2:2001	IS 5182 PART 6:2006
Colliery	S.NO.	Cat.	Site Name					
Nigahi O/C Mine	C1	A	Manager Office	478	211	-	27.21	39.72
	C2	B	Nigahi colony Entrance	341	182	-	18.14	27.30
	C3	B	Nigahi Market	301	178	52	19.68	30.43
Jayant O/C Mine	C4	A	Manager Office	379	196	-	23.24	37.39
	C5	B	Jayant Gol Market	156	123	46	13.7	24.5
Amlori	C6	A	Manager Office	424	198	-	21.56	37.21
O/C Mine	C7	B	Near Colony Dispensary	188	109	43	17.90	28.74
Kakri O/C Mine	C8	A	Manager Office	642	306	-	46.95	69.41
	C9	A	Excavation Office	588	279	-	42.38	63.08
	C10	B	Kakri Main Gate	316	214	72	23.32	38.64
Khadia O/C Mine	C11	A	Manager Office	353	127	-	19.85	28.69
	C12	B	Near Civil Office	130	99	37	12.98	26.46
Jhingurda O/C Mine	C13	A	Manager Office	527	237	-	38.56	60.14
	C14	B	Jhingurda Colony	190	203	51	28.64	52.37

Table 1:

Assessment of air quality monitoring data showed that all particulate and gaseous pollutants (SPM, PM₁₀, PM_{2.5}, SO₂ and NO₂). Concentrations of all types of particulate matters were at the peak during monitoring at various the sites. Among the various sites, the higher concentrations of SPM were observed for industrial and residential areas at Kakri OCM, jhingurda OC mine and Nigahi OC mine situated near active mining and the coal siding locations. SPM concentration exceeded the prescribed limit of NAAQS (500 µg m⁻³; CPCB 1995) in Kakri OCM, Jhingurda OCM during monitoring. Coal dust was reported as the major pollutant in the air of open cast coal mining areas and the coal siding areas during monitoring. The primary source of coal dust at fully operational surface mine may include overburden removal and blasting, mineral haulage and transportation, mechanical handling operations etc.

The concentrations of PM₁₀ at Nigahi OCM ,at Kakri OCM and Jhingurda OCM during monitoring were found respectively 211, 306 ,237 µg m⁻³and were 2.1, 3.0 and 2.3 times higher than NAAQS (100 µg m⁻³ CPCB 2009) guidelines of India and so as PM_{2.5} .

The coarse particles PM₁₀ and fine particles PM_{2.5} are formed due to mechanical disruption like crushing, grinding and abrasion of surface, evaporation of various sprays with re-suspension of dust near coal mining areas hence proportions of coarse, fine particles were high in these coal mining sites. Lower concentration of particulates at Jayant OCM and Khadia OCM is due to the fact that the coal siding site is far away from the mining areas and mines are underground. Study of pollutant dispersion mechanisms suggested that the topography and the meteorological conditions of area strongly influence the concentrations of particulate matter. Higher concentrations of particulate matter

is at low temperature and low wind speed caused by lower mixing height and poor dispersion conditions.

The concentrations of SO₂ and NO₂ are found satisfactory and within the limits for coal siding areas as well as in residential areas near mines. This could be due to fact that these mines are surrounded by forest area and no major polluting agent is found. but, from the extracted data it is clearly seen that level of SO₂ and NO₂ near mining activity is higher than that of far located areas.

IV. CONCLUSION

Assessment of air quality monitoring data in SINGRAULI COALFEILDS showed significant spatial variations in concentrations of PM₁₀, PM_{2.5}, SO₂, NO₂ and SPM depending on pollutant emission and pollutant dispersion mechanisms, also being influenced by meteorological conditions and distance of the site from sources. Wind speed, relative humidity, temperature are also the governing parameters in air pollutant concentrations in the area Sites near coal mining areas. Open cast mines creates a significant amount of pollution as all the works related to mining such as drilling, blasting, overburden loading and unloading, and transportation are open to direct atmosphere. Emission of windblown dust is through unpaved roads and over burdens.to control this pollution strict Pollution prevention rules and laws, advanced mining technology, effective strategies as well as public awareness and education should be implemented around coal mining areas.

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