"IMPACT OF COAL MINING ON AMBIENT AIR: A CASE STUDY OF JAMUNA KOTMA COAL MINES AREA"

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Abstract - Coal is a major source of energy in India for many decades and assumed to contributes to nearly 60% of India's energy requirement. Coal mining adversely affects the eco-system 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 Jamuna Kotma Coal Field Region in the district of Anuppur, Madhya Pradesh (India).

Keywords: Air pollution, coal mining, environment, impacts, Jamuna Kotma, pollution.

Abbreviations: U/G – Underground, OCM- Opencast mine, SPM – Suspended particulate matter,

PM- Particulate matter, SO_2- Sulphur Dioxide, NO_2- Nitrogen Dioxide

1. 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 affect 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.

2.Materials and Methods

2.1.Study area

Jamuna Kotma area is located in Anuppur District of Madhya Pradesh. Anuppur situated between latitude 23 0' and 23 15' and longitude 81 45' and 82 05'0. The surface has maximum elevation of 573.47 and minimum elevation 512.42 m respectively from Mean Sea Level. National Highway 78 is also passing along northern side of the area. Regional mine headquarter is situated about 6.5 km south of Kotma railway station. Kewai River is passing along the north-south side of monitoring area. The area is gently undulating with the general slope towards River Kewai (Area falls under SOI toposheet No. 64E/16 and 64I/4). The temperature varies here from 4.9 to 44 ^{0}c with average annual rainfall of 1430 mm.

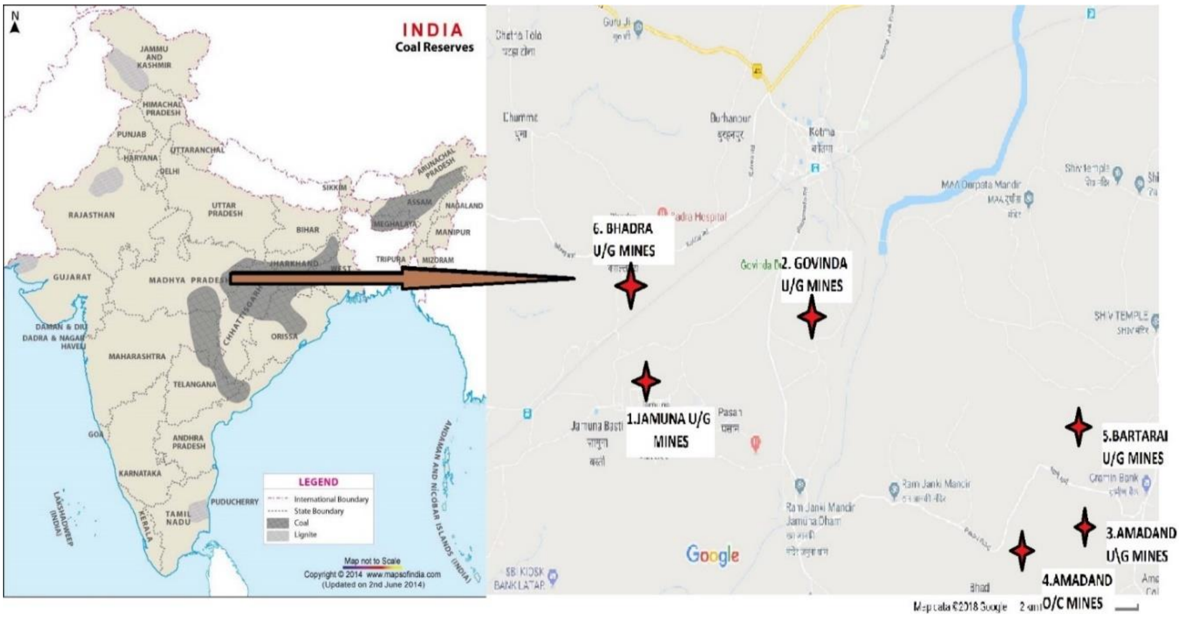


Fig1: location of various coal mines

For air quality monitoring, SIX number of monitoring colliery sites were selected. These collieries are Bhadra UG mine, Jamuna UG mine, Govinda UG mine, Amadand OCM, Amadand UG mine, Bartarai UG mine were selected in different directions and distances in coal mining area of Jamuna Kotma coal mining area.

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

S. No.	Colliery	Cat.	Site Name
1.	Jamuna U/G Mine	A	Manager Office
		B	Filter Plant
		B	Jamuna Colony
2.	Govinda U/G Mine	A	Meera Incline
		B	Govinda Filter Plant
3.	Amadand U/G Mine	A	Amadand Incline
		B	Near Colony Dispensary
4.	Amadand O/C Mine	A	Excavation Office
		A	Sub Area Office
		B	Kuhka Village
5.	Bartarai U/G Mine	A	Bartarai Incline
		B	Near Civil Office
6.	Bhadra U/G Mine	A	Near Manager Office
		B	Bhadra Colony

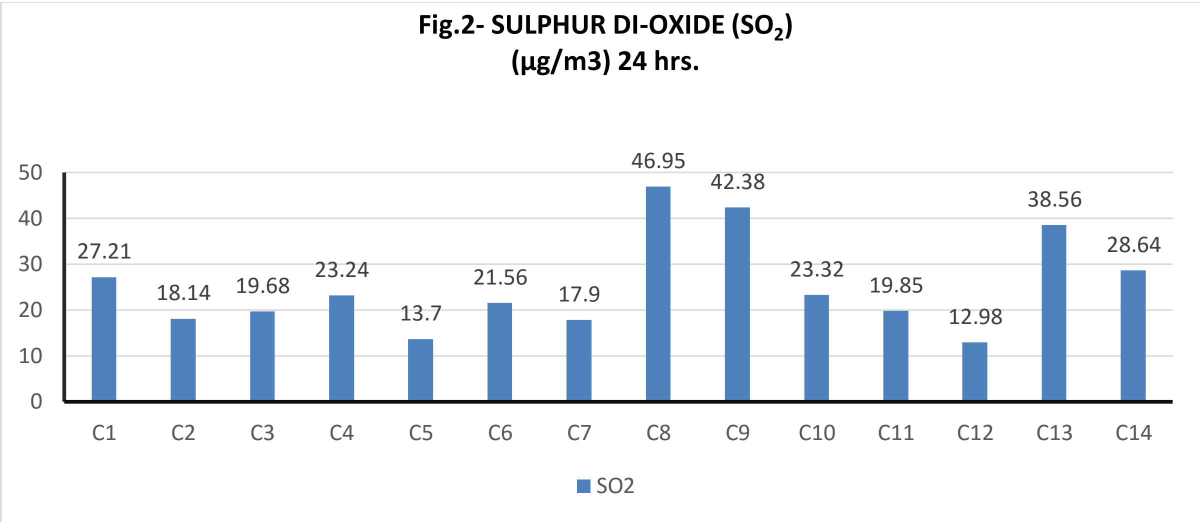
Cat. - A- Industrial, B-Residential

2.2. Methods of Monitoring for particulate and gaseous pollutants:

The air quality monitoring for SPM, PM2.5, 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:

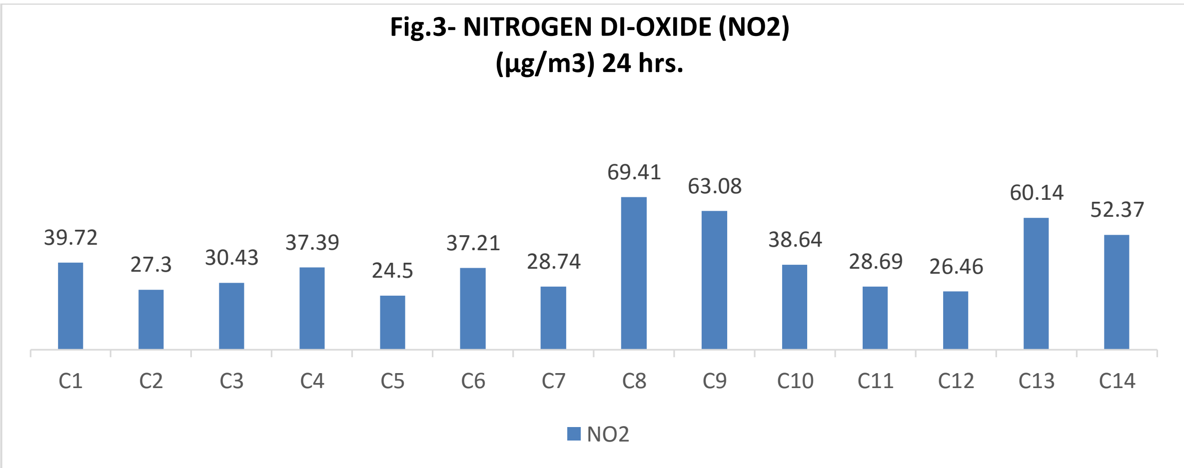
SO_X :

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 tetra-mercurate 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:



NO_2 :

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 ($NaAsO^{2-}$) (IS 5182 PART 6:2006). The concentration of nitrite ion (NO_{2-}) 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:

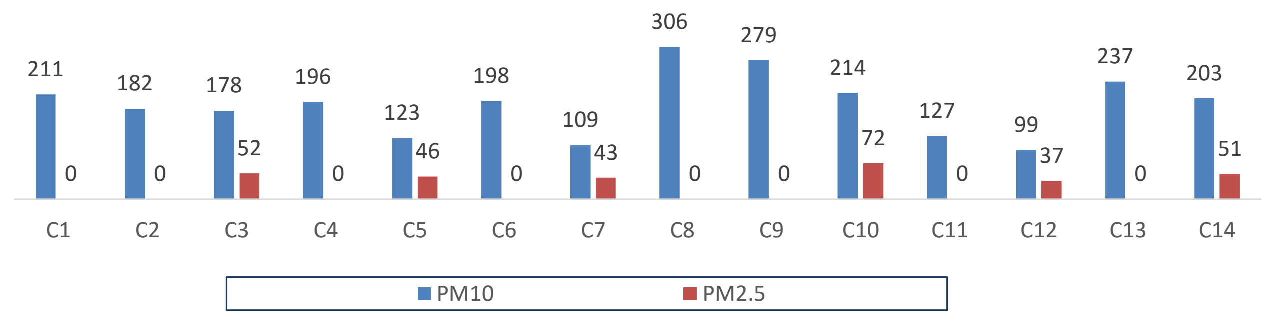


SPM :

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 PM2.5.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).

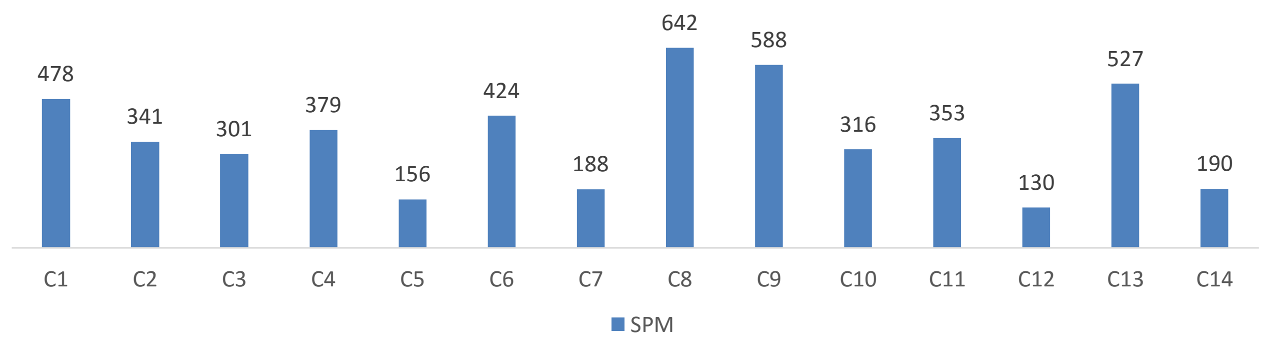
PM_{10} and **$PM_{2.5}$** of various sites are as under:

Fig.4- PARTICULATE MATTER (PM_{10} AND $PM_{2.5}$) (µg/m3) 24 hrs.



SPM of various sites are as under:

Fig.5- SUSPENDED PARTICULATE MATTER (µg/m3) 24 hrs.



3. Results and Discussion:

PARAMETER				SPM	PM_{10}	$PM_{2.5}$	SO_2	NO_2
LIMIT ($\mu g/m^3$) 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					
Jamuna U/G Mine	C1	A	Manager Office	478	211	-	27.21	39.72
	C2	B	Filter Plant	341	182	-	18.14	27.30
	C3	B	Jamuna Colony	301	178	52	19.68	30.43
Govinda U/G Mine	C4	A	Meera Incline	379	196	-	23.24	37.39
	C5	B	Govinda Filter Plant	156	123	46	13.7	24.5
Amadand	C6	A	Amadand Incline	424	198	-	21.56	37.21

U/G Mine	C7	B	Near Colony Dispensary	188	109	43	17.90	28.74
Amadand O/C Mine	C8	A	Excavation Office	642	306	-	46.95	69.41
	C9	A	Sub Area Office	588	279	-	42.38	63.08
	C10	B	Kuhka Village	316	214	72	23.32	38.64
Bartarai U/G Mine	C11	A	Bartarai Incline	353	127	-	19.85	28.69
	C12	B	Near Civil Office	130	99	37	12.98	26.46
Bhadra U/G Mine	C13	A	Near Manager Office	527	237	-	38.56	60.14
	C14	B	Bhadra Colony	190	203	51	28.64	52.37

Assessment of air quality monitoring data showed that all particulate and gaseous pollutants (SPM, PM10, PM2.5, 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 Amadand OCM, Bhadra U/G mine and Jamuna U/G 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 Amadand OCM, Bhadra U/G mine 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 Jamuna U/G mine at Amadand OCM and Bhadra U/G mine during monitoring were found respectively 211, 306 ,237 μg $m^{-3}$and 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 PM_{10} 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 Bartarai U/G mine and Govinda U/G mine 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 NO_2 are found satisfactory and with in 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 NO_2 near mining activity is higher than that of far located areas.

4. Conclusion:

Assessment of air quality monitoring data in JAMUNA KOTMA COALFEILDS showed significant spatial variations in concentrations of PM10, PM2.5, 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. The pollution created in underground mines is due to open coal siding, processing, machinery and Vehicular movement. 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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