MONITORING REPORT

ENVIRONMENTAL QUALITY MONITORING, MITIGATIVE MEASURES AND RELATED ADVICE FOR KATHAUTIA OPEN CAST COAL MINE, DALTONGANJ, JHRKHAND

(POST MONSOON &WINTER SEASON)
(OCTOBER, 2019 TO MARCH, 2020)

Prepared

For

M/S HINDALCO INDUSTRIES LIMITED
Daltonganj-822101
Jharkhand

Prepared

by

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Report

On

Environmental Quality Monitoring, Mitigative Measures and Related Advice for Kathautia Open Cast Coal Mine, Daltonganj, Jhrkhand

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(OCTOBER, 2019 TO MARCH, 2020)

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CONTENTS

LIST OF TABLE

1.0 INTRODUCTION

Mining is a site specific and ecologically sensitive industry. For sustaining national development, mining of coal and minerals is of paramount importance for developed as well as developing countries. To meet the energy requirements of the country, increased coal production has been possible due to large-scale surface mining activities. Surface mining causes environmental disturbance in the form of land degradation, removal of OB material stress on air and water regime and finally interferes in the balance of the ecosystem. To meet these problems, sound environmental management system for pre-mining, active mining and post mining stages in the form of Environmental Impact Assessment, Environmental Management Practice for concurrent mining and Environmental Audit has been made necessary by the regulating state and central authorities. Regular monitoring of the different components of environment is made necessary for evaluating the requirements of environmental management system and its impact in the society. This report presents such study conducted by CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad for **Kathautia Open Cast Coal Mine** belonging to **M/S Hindalco Industries Ltd, Daltonganj.**

i) LOCATION

The lease area of KOCCM covers land in villages: Kathautia, Kajari, Garikhas, Palhekhurd, Sakhui, Sikka and Batsara in Patan and Pandwa Blocks of district Palamau (Jharkhand). Kathautia Open Cast Coal Mines (KOCCM), is located in southern boundary of the block is about 10 KM from Daltonganj. The project area is situated between the latitude 24^0 07' 02" N and 24^0 08' 52" N and longitude 84^0 03' 42" E & 84^0 06' 52" E. The site is well connected by road and 15 km away from Daltonganj. The project came into operation in the year 2008.

M/s Hindalco Industries Ltd, Daltonganj; approached CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad for doing the following work for one year i.e. April 2019 to March 2020.

- Environmental study of Air, Water, Soil, Noise, Flora & fauna of the core and buffer zone.
- The Environmental monitoring will be conducted on seasonal basis.
- Advice into the adoption of necessary control measures.
- Preparation of Environmental Statement as stipulated in consent to operate of JSPCB, Ranchi.

The detailed studies with respect to air, water and noise will be carried on seasonal basis in the year 2019-20 while soil samples, for the adjoining mining area, will be collected once in a year and analyzed in the CSIR-CIMFR laboratory.

2.0 (i) MINING SCENARIO

At KOCCM, Pandwa Top & Rajhara B seams have been worked out by opencast mining with shovel and dumper combinations. Shovels of different capacities such as 3.0 cubic meters, 2.7 cubic meters and 2.1 cubic meters are used along with 25 T Volvo Dumpers.

The coal seams in this OCP are as follows:

(i)	Rajhara A seam	->	0.4 – 2.67 mts thick
(ii)	Rajhara B seam	->	0.42 – 2.60 mts thick
(iii)	Pandwa Top seam	->	0.25 – 3.11 mts thick

The average grade of coal is 'B' & 'D'. The open cast mine is worked by Shovel-Dumper combination with an average stripping ratio of 1:9.66. Till the bottom most seams are worked out and quarry benches advance sufficiently, backfilling will be allowed and backfilling of Overburden has already been started.

The working area by opencast method is having the seams Pandwa Top, Rajhara B & Rajhara A. The grades of coal of the seams are mostly found as B & D. The total Block area of this block is approximately 938.27 ha out of which, 687.93 ha is granted for Mining Lease.

(ii) REGIONAL GEOLOGY

The Daltonganj coalfield occupies an elongated area of 250 sq km along a narrow east west trend north of Daltonganj (24^0 02' 00"; 84^0 04' 00") and falls between latitude 24^0 00' 00" and 24^0 12' 00" N and longitudes 83^0 59' 00" and 84^0 15' 00" E. However, the lower Gondwana coal seams underlie only 95 sq km, the Talchir Formation occupying the entire remaining area. Sequence of Karharbari seam is given below:-

SEQUENCE OF KARHARBARI COAL SEAMS, DALTONGANJ COALFIELD

S. N.	Particulars	Thickness range (meters)
1	*Major coal seams*	
	a) Top cover over Rajhara A seam	10.25 – 44.75
	Rajhara A seam	0.4 – 2.67
	b) Parting cover over Rajhara B seam	4.20 – 15.30
	Rajhara B seam	0.42 – 2.60
	(c) Parting cover over Pandwa Top seam	4.70 – 13.87
	Pandwa Top seam	0.25 – 3.11
2	*Gradient of strata (degree)*	*1 in 22.16 (*2^0 35' 1.67")
3	Category of excavation :	
	(a) Weathered rock (cat)	
	(b) Overburden rock (cat)	
	(c) Coal (cat)	

3.0 ENVIRONMENTAL SCENARIO IN THE MINING AREA

3.1 AIR ENVIRONMENT

3.1.1 SOURCES OF AIR POLLUTION

Coal transportation, OB removal, drilling, blasting, haul road and movements of mining equipments are the major sources of air pollution in the area. Generally, dust generation is of major concern. NO_2 is liberated in the time of blasting and during the movement of mining machineries. This coal contains very less sulphur and as such the concentration of SO_2. In Indian coal, it is low, except Assam where sulphur content is high.

3.1.2 METHODOLOGY & INSTRUMENTS USED:

The methodology and instruments used for air quality monitoring and analysis are given in **Table 1** as below:

Table 1: Methodology and Instrument Used for Air Quality Analysis

Parameters	Method	Instrument
$PM_{2.5}$	IS-5182 (Part 23):2006 Gravimetric Method Beta attenuation Method	Fine Particulate Sampler
PM_{10}	IS-5182 (Part 23):2006 Gravimetric Method Beta attenuation Method	Fine Particulate Sampler / Respirable Dust Sampler (RDS)
SO_2	IS-5182 (Part 2):2001 (Improved West & Gaeke method)	Fine Particulate Sampler/RDS with gaseous attachment
NO_x	IS-5182 (Part 6):2006 (Jacob & Hochheiser modified method)	Fine Particulate Sampler/RDS with gaseous attachment

3.1.3 AIR QUALITY

Air quality monitoring in core and buffer zone of the Kathautia Open Cast mine has been carried out in post monsoon and winter seasons for the year 2019-20 to assess the impact of mining activities on the ambient air quality. During the study, sampling locations for ambient air quality had been fixed in buffer zone and core zone area. Details

of sampling stations along with the source of air pollution are given in **Table 2.** The air quality data at these locations is presented from **Tables 3-6**.

Table 2: Details of Sampling Locations

Stn. Code	Location	Source of Air Pollution
CORE ZONE		
CA_1	Near Mine Site Office	Mining activity, Kachha road and vehicular movement.
CA_2	Near Haul Road	Mining activity and vehicular movement.
CA_3	Near Stockyard	Mining activity and vehicular movement.
CA_4	Near Weigh Bridge	Mining activity and vehicular movement.
BUFFER ZONE		
BA_1	R. R. Colony	Household coal burning and vehicular movement, etc.
BA_2	Batsara Village	Household coal burning and vehicular movement, etc.

Table 3: Ambient Air Quality Report for Core Zone

Sampling Code	Sampling Location	Season	Parameters (µg/m^3)				Remarks
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	
CA_1	Near Mine Site Office	Post monsoon	51.6	90.8	20.6	28.2	
CA_2	Near Haul Road	Post monsoon	58.1	96.1	22.1	31.5	
CA_3	Near Stockyard	Post monsoon	57.5	94.8	22.3	29.5	
Standards as per NAAQS-2009			**60**	**100**	**80**	**80**	

Table 4: Ambient Air Quality Report for Buffer Zone

Sampling Code	Sampling Location	Season	Parameters (µg/m^3)				Remarks
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	
BA_1	R. R. Colony	Post monsoon	52.2	71.1	23.1	26.6	
BA_2	Batsara Village	Post monsoon	54.6	74.0	24.7	25.3	
Standards as per NAAQS-2009			**60**	**100**	**80**	**80**	

Table 5: Ambient Air Quality Report for Core Zone

Sampling Code	Sampling Location	Season	Parameters (µg/m^3)				Remarks
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	
CA_1	Near Mine Site Office	Winter	52.8	93.1	23.0	38.0	
CA_2	Near Haul Road	Winter	57.9	90.1	23.5	40.0	
CA_3	Near Stockyard	Winter	57.8	90.5	22.2	32.9	
CA_4	Near Weigh Bridge	Winter	58.4	95.6	22.9	39.3	
Standards as per NAAQS-2009			**60**	**100**	**80**	**80**	

Table 6: Ambient Air Quality Report for Buffer Zone

Sampling Code	Sampling Location	Season	Parameters (µg/m^3)				Remarks
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	
BA_1	R. R. Colony	Winter	55.9	76.3	25.3	28.0	
BA_2	Batsara Village	Winter	51.8	67.3	23.7	25.5	
Standards as per NAAQS-2009			**60**	**100**	**80**	**80**	

3.1.4 RESULTS AND DISCUSSIONS

During post monsoon season, the average $PM_{2.5}$ concentration level at Near Mine Office in core zone was found 51.6 μg/m^3 and the average concentration of PM_{10} was found 90.8μg/m^3. At Haul Road concentration level of $PM_{2.5}$ was 58.1 μg/m^3 and PM_{10} was found 96.1 μg/m^3. Near Stockyard concentration level of $PM_{2.5}$ was found 57.5 μg/m^3 and PM_{10} was 94.8 μg/m^3. In the core zone, all the $PM_{2.5}$ and PM_{10} values are within the threshold value i.e. 60 μg/m^3 for $PM_{2.5}$ and 100 μg/m^3 for PM_{10} as per the guideline of National Ambient Air Quality Standard (NAAQS), 2009 around the entire sampling site. Concentration of SO_2 and NO_2 are also found within the limit of 80 μg/m^{3}as per the guideline of NAAQS, 2009 in all the sampling sites of core zone of the mine.

During post monsoon season, the $PM_{2.5}$ concentration at R. R. Colony in buffer zone was found 52.2 μg/m^3 and the average concentration of PM_{10} was found 71.1 μg/m^3. At Batsara Village, the $PM_{2.5}$ concentration was found 54.6 μg/m^3 and the concentration of PM_{10} was found 74.0 μg/m^3. In the buffer zone both the concentration levels are within the threshold value i.e. 60 μg/m^3 for $PM_{2.5}$ & 100 μg/m^3 for PM_{10} as per the guideline of NAAQS, 2009. Concentration of SO_2 and NO_2 are also found within the limit 80 μg/m^{3}as per the guideline of NAAQS, 2009 in all the sampling sites of core zone of the mine. The results show that the ambient air quality of the villages, in and around the mining site, was least affected as the mining of coal was not being during the winter season.

During winter season, the average $PM_{2.5}$ concentration level at Near Mine Office in core zone was found 52.8 μg/m^3 and average concentration of PM_{10} was found 93.1μg/m^3. At Haul Road concentration level of $PM_{2.5}$ was 57.9 μg/m^3 and PM_{10} was found 90.1 μg/m^3. Near Stockyard concentration level of $PM_{2.5}$ was found 57.8 μg/m^3 and PM_{10} was 90.5 μg/m^3. Near Weigh Bridge concentration level of $PM_{2.5}$ was found 58.4 μg/m^3 and PM_{10} was 95.6 μg/m^3. In the core zone, all the $PM_{2.5}$ and PM_{10} values are within the threshold value i.e. 60 μg/m^3 for $PM_{2.5}$ and 100 μg/m^3 for PM_{10} as per the guideline of National Ambient Air Quality Standard (NAAQS), 2009 around the entire sampling site. Concentration of SO_2 and NO_2 are also found within the limit of 80 μg/m^{3}as per the guideline of NAAQS, 2009 in all the sampling sites of core zone of the mine.

During winter season, the $PM_{2.5}$ concentration at R. R. Colony in buffer zone was found 55.9 $\mu g/m^3$ and the concentration of PM_{10} was found 76.3 $\mu g/m^3$. At Batsara Village, the $PM_{2.5}$ concentration was found 51.8 $\mu g/m^3$ and the concentration of PM_{10} was found 67.3 $\mu g/m^3$. In the buffer zone both the concentration levels are within the threshold value i.e. 60 $\mu g/m^3$ for $PM_{2.5}$ & 100 $\mu g/m^3$ for PM_{10} as per the guideline of NAAQS, 2009. Concentration of SO_2 and NO_2 are also found within the limit 80 $\mu g/m^3$as per the guideline of NAAQS, 2009 in all the sampling sites of core zone of the mine. The results show that the ambient air quality of the villages, in and around the mining site, was least affected as the mining of coal was not being during the winter season.

3.2 WATER ENVIRONMENT

3.2.1. SOURCES OF WATER POLLUTION

Mine Water

No adverse impact on surface water is anticipated as the main surface water regime is not proposed to be disturbed except for the drainage having their catchment within the ML area. The mine water, which is mainly rain water and ground water seepage, is used for industrial purposes like dust suppression by water tankers in haul roads, approach roads, stockyards and watering of plants in the overburden dumps & office premises.

Domestic Effluents/Sewage

There are minimum housing facilities within the ML area for essential services comprising about 100 inhabitants. The domestic wastes from these houses are led to septic tanks. As the domestic waste water is minimum, the possibility of pollution is remote/insignificant. However, proper care has been taken up in the shelters area of inhabitants for sewage discharge.

3.2.2 INSTRUMENTS USED

a) pH and Conductivity meter
b) Ion Meter,
c) COD Analyser,
d) BOD Analyser,
e) Water Analysis Kit, (HACH, DR - 2000)
f) Microwave Digestion
g) UV-VIS Spectrophotometer (Simazdo)
h) Atomic Absorption Spectrophotometer (Varian)
i) Ion Chromatograph (Dionex/Metrohm)
j) Flame Photometer
k) ICP-MS (Perkin Elmer)

3.2.3 WATER QUALITY OF THE AREA

To assess the water quality in and around the study area, mine water, ground water and surface water were collected and analysed. During the lean periods, mine water is used for water spraying on haul roads, plantation and other mining activities. To assess the water quality of the area water samples from six locations (Pit-A mine pit water, Pit-B mine pit water, Pit-C mine pit water, Pit-D mine pit water, hand pump water of R. R. Colony/Kajari Village and tube well water of Batsara village were collected during post monsoon and winter seasons. The analysis was carried out in the field as well as CSIR-CIMFR Laboratory and results are presented from **Table 7** to **10.**

During post monsoon season, in the core zone, the mine water quality of all the pits does not show any high value as it remains within the pit, where the contaminants settle before the mine water used for industrial as well as plantation purposes. TSS, COD, Mineral oil, trace metals and other parameters are found within their respective threshold limits. All other cationic and anionic parameters are also well below their respective threshold values. The mine water quality is well within the prescribed limit of MoEF&CC Schedule-VI standard.

During post monsoon season, in the buffer zone, water quality of nearby well and tube well show that there is no significant impact of mining on water quality of region. TSS, TDS, Mineral oil, trace metals and other parameters are found within their respective threshold limits. The Total hardness value in the sample of R. R. Colony as well as Batsara village is slightly higher than acceptable limit of 200mg/l but lower than the permissible limit in the absence of alternate sources i.e 600mg/l. The alkalinity value in the sample of R. R. colony is below the acceptable limit but in the sample of Batsara village is slightly higher than the acceptable limit of 200mg/l while lower than the permissible limit in the absence of alternate sources of 600mg/l. All other cationic and anionic parameters are well below their respective threshold values.

During winter season, in the core zone, the mine water quality of all the pits also does not show any high value as it remains within the pit, where the contaminants settle before the mine water used for industrial as well as plantation purposes. TSS, COD, Mineral oil, trace metals and other parameters are found within their respective threshold limits. All other cationic and anionic parameters are also well below their respective threshold values. The mine water quality is well within the prescribed limit of MoEF&CC Schedule-VI standard.

During winter season, in the buffer zone, water quality of nearby well and tube well show that there is no significant impact of mining on water quality of region. TSS, Mineral oil, trace metals and other parameters are found within their respective threshold limits. The Total hardness value in the sample of R. R. Colony as well as Batsara village is slightly higher than acceptable limit of 200mg/l but lower than the permissible limit in the absence of alternate sources i.e 600mg/l. The alkalinity values in the sample of R. R. colony and Batsara village are higher than the acceptable limit of 200mg/l while lower than the permissible limit in the absence of alternate sources of 600mg/l. The total dissolve solids (TDS) value at R. R. colony is found within their respective threshold limits but in the sample of Batsara village is slightly higher than the acceptable limit of 500mg/l while lower than the permissible limit in the absence of alternate sources of 2000mg/l. All other cationic and anionic parameters are well below their respective threshold values.

Table 7: Mine Discharge Water Quality Data

Area: Core Zone	**Season: Post Monsoon**
Project: Kathuatia OC Mine	**Date of Sampling: 26.12.2019**
Name of the Sampling Station:	
W_1- Pit-A Mine Water	**W_2- Pit-B Mine Water**
W_3- Pit-C Mine Water	**W_4- Pit-D Mine Water**

Sl. No.	**Parameters**	**Station Code**				**MoEF&CC Sch.-VI Standard**
		W_1	**W_2**	**W_3**	**W_4**	
1.	Colour, Hazen units, Max	<5	<5	<5	<5	5
2.	Odour	#	#	#	#	#
3.	Total suspended solids, mg/l, Max	45	40	52	55	100
4.	pH	8.15	7.83	8.46	8.42	6.5-8.5
5.	Temperature (^{0}C)	19.1	19.1	19.2	19.0	$
6.	Oil & Grease, mg/l, Max	1.8	1.5	1.1	1.4	10
7.	BOD (3days at 27^{o}C), mg/l, Max	3.0	0.8	0.8	4.0	30
8.	COD, mg/l, Max	34.2	31.5	36.1	38.5	250
9.	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	<0.001	1.0
10.	Arsenic (as AS), mg/l, Max	0.013	0.054	0.006	0.028	0.2
11.	Lead (as Pb), mg/l, Max	0.001	0.001	0.001	0.001	0.1
12.	Cadmium (as Cd), mg/l, Max	<0.001	<0.001	<0.001	<0.001	2.0
13.	Hexavalent Chromium (as Cr^{6+}), mg/l, Max	0.004	0.003	0.003	0.003	0.1
14.	Total Chromium (as Cr), mg/l, Max	0.006	0.005	0.004	0.005	2.0
15.	Copper (as Cu), mg/l, Max	0.003	0.003	0.004	0.004	3.0
16.	Zinc (as Zn), mg/l, Max	0.011	0.117	0.016	0.045	5.0
17.	Selenium (as Se), mg/l, Max	0.002	0.001	0.003	0.002	0.05
18.	Nickel (as Ni), mg/l, Max	0.004	0.006	0.006	0.004	3.0
19.	Fluorides (as F), mg/l, Max	0.68	1.01	1.03	0.83	2.0
20.	Dissolved Phosphate (as P), mg/l, Max	<0.1	<0.1	<0.1	<0.1	5.0
21.	Manganese (as Mn), mg/l, Max	0.002	0.041	0.006	0.006	2.0
22.	Iron (as Fe), mg/l, Max	0.030	0.083	0.063	0.046	3.0
23.	Nitrate (as N), mg/l, Max	0.54	0.25	0.24	0.25	10
24.	Calcium (as Ca), mg/l, Max	40.37	72.33	43.73	43.78	NS
25.	Magnesium (as Mg), mg/l, Max	14.39	30.97	9.43	15.26	NS
26.	Sodium (as Na), mg/l, Max	15.8	33.8	29.2	35.2	NS
27.	Potassium (as K), mg/l, Max	1.0	3.3	2.0	2.7	NS
28.	Total Hardness (as $CaCO_3$)	160	308	148	172	NS
29.	Total Dissolved Solid, mg/l, Max	270	502	303	335	NS

Unobjectionable;
NS: *Not Specified* ***$****: Temperature shall not exceed 5^{o}C above the receiving water temp.*

Table 8: Ground Water Quality Data

Area: Core Zone/Buffer Zone	**Season: Post Monsoon**
Project: Kathuatia OC Mine	**Date of Sampling: 26.12.2019**
Name of the Sampling Station:	
W_5 - ***Hand Pump Water, R. R. Colony/Kajari Village***	**W_6 -** ***Hand Pump Water, Batsara Village***

Sl. No.	**Parameters**	**Station Code**		**IS-10500: 2012**	
		W_5	**W_6**	**Acceptable Limit**	**Permissible Limit in the Absence of Alternate**
1.	Colour, Hazen units, Max	<5	<5	5	15
2.	Odour	Agreeable	Agreeable	Agreeable	Agreeable
3.	Taste	Agreeable	Agreeable	Agreeable	Agreeable
4.	Turbidity, NTU, Max	0.52	0.61	1.0	5.0
5.	pH	7.91	7.83	6.5-8.5	No relaxation
6.	Total Hardness (as $CaCO_3$)	236	264	200	600
7.	Iron (as Fe), mg/l, Max	0.037	0.189	0.3	No relaxation
8.	Chloride (as Cl^-), mg/l, Max	13.99	15.99	250	1000
9.	Total Dissolved Solid,mg/l, Max	436	397	500	2000
10.	Calcium (as Ca), mg/l, Max	89.15	99.25	75	200
11.	Magnesium (as Mg), mg/l, Max	3.25	3.93	30	100
12.	Sodium (as Na), mg/l, Max	14.1	17.3	NS	NS
13.	Potassium (as K), mg/l, Max	0.8	1.4	NS	NS
14.	Manganese (as Mn), mg/l, Max	0.002	0.026	0.10	0.30
15.	Sulphates (as SO_4^{--}), mg/l, Max	3.74	3.10	200	400
16.	Nitrate (as NO_3), mg/l, Max	17.47	6.15	45	No relaxation
17.	Fluorides (as F), mg/l, Max	1.17	0.52	1.0	1.5
18.	Arsenic (as AS), mg/l, Max	0.009	0.008	0.01	0.05
19.	Cadmium (as Cd), mg/l, Max	<0.001	<0.001	0.003	No relaxation
20.	Lead (as Pb), mg/l, Max	0.001	0.004	0.01	No relaxation
21.	Copper (as Cu), mg/l, Max	0.004	0.004	0.05	1.5
22.	Hexavalent Chromium (as Cr^{6+}), mg/l, Max	0.003	0.004	0.05	No relaxation
23.	Selenium (as Se), mg/l, Max	0.001	0.002	0.01	No relaxation
24.	Silver (as Ag), mg/l, Max	0.021	0.016	0.03	0.2
25.	Zinc (as Zn), mg/l, Max	0.011	0.053	5	15
26.	Total Alkalinity, mg/l, Max	196	300	200	600
27.	Mineral Oil, mg/l, Max	<0.001	<0.001	0.5	No relaxation

NS: *Not Specified*

Table 9: Mine Discharge Water Quality Data

Area: Core Zone	**Season: Winter**
Project: Kathuatia OC Mine	**Date of Sampling: 20.02.2020**
Name of the Sampling Station:	
W_1- Pit-A Mine Water	**W_2- Pit-B Mine Water**
W_3- Pit-C Mine Water	**W_4- Pit-D Mine Water**

Sl. No.	**Parameters**	**Station Code**				**MoEF&CC Sch.-VI Standard**
		W_1	**W_2**	**W_3**	**W_4**	
1.	Colour, Hazen units, Max	<5	<5	Sample not available.	<5	5
2.	Odour	#	#		#	#
3.	Total suspended solids, mg/l, Max	38	35		41	100
4.	pH	8.07	7.76		7.68	6.5-8.5
5.	Temperature (^{0}C)	24.0	24.0		24.0	$
6.	Oil & Grease, mg/l, Max	1.6	1.4		1.3	10
7.	BOD (3days at 27^{o}C), mg/l, Max	1.72	1.12		4.64	30
8.	COD, mg/l, Max	32.5	29.8		34.2	250
9.	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001		<0.001	1.0
10.	Arsenic (as AS), mg/l, Max	<0.001	<0.001		<0.001	0.2
11.	Lead (as Pb), mg/l, Max	<0.001	<0.001		<0.001	0.1
12.	Cadmium (as Cd), mg/l, Max	<0.001	<0.001		<0.001	2.0
13.	Hexavalent Chromium (as Cr^{6+}), mg/l, Max	0.003	0.004		0.004	0.1
14.	Total Chromium (as Cr), mg/l, Max	0.005	0.006		0.005	2.0
15.	Copper (as Cu), mg/l, Max	<0.001	<0.001		<0.001	3.0
16.	Zinc (as Zn), mg/l, Max	0.006	0.029		0.018	5.0
17.	Selenium (as Se), mg/l, Max	0.001	0.002		0.001	0.05
18.	Nickel (as Ni), mg/l, Max	0.003	0.004		0.003	3.0
19.	Fluorides (as F), mg/l, Max	0.88	1.14		1.00	2.0
20.	Dissolved Phosphate (as P), mg/l, Max	<0.1	<0.1		<0.1	5.0
21.	Manganese (as Mn), mg/l, Max	0.004	0.015		0.004	2.0
22.	Iron (as Fe), mg/l, Max	0.058	0.116		0.086	3.0
23.	Nitrate (as N), mg/l, Max	0.46	0.40		0.32	10
24.	Calcium (as Ca), mg/l, Max	45.41	68.96		47.09	NS
25.	Magnesium (as Mg), mg/l, Max	18.13	30.09		18.08	NS
26.	Sodium (as Na), mg/l, Max	20.5	45.5		43.0	NS
27.	Potassium (as K), mg/l, Max	4.6	5.2		6.1	NS
28.	Total Hardness (as $CaCO_3$)	188	296		192	NS
29.	Total Dissolved Solid, mg/l, Max	296	496		358	NS

Unobjectionable;
NS: *Not Specified* ***$****: Temperature shall not exceed 5^{o}C above the receiving water temp.*

Table 10: Ground Water Quality Data

Area: Core Zone/Buffer Zone	**Season: Winter**
Project: Kathuatia OC Mine	**Date of Sampling: 20.02.2020**
Name of the Sampling Station:	
W_5 - *Hand Pump Water, Kajari Village*	**W_6 - *Hand Pump Water, Batsara Village***

Sl. No.	**Parameters**	**Station Code**		**IS-10500: 2012**	
		W_5	**W_6**	**Acceptable Limit**	**Permissible Limit in the Absence of Alternate**
1.	Colour, Hazen units, Max	<5	<5	5	15
2.	Odour	Agreeable	Agreeable	Agreeable	Agreeable
3.	Taste	Agreeable	Agreeable	Agreeable	Agreeable
4.	Turbidity, NTU, Max	0.62	0.48	1.0	5.0
5.	pH	7.03	7.00	6.5-8.5	No relaxation
6.	Total Hardness (as $CaCO_3$)	284	356	200	600
7.	Iron (as Fe), mg/l, Max	0.235	0.185	0.3	No relaxation
8.	Chloride (as Cl^-), mg/l, Max	35.0	15.0	250	1000
9.	Total Dissolved Solid, mg/l, Max	402	593	500	2000
10.	Calcium (as Ca), mg/l, Max	85.78	90.83	75	200
11.	Magnesium (as Mg), mg/l, Max	16.96	31.40	30	100
12.	Manganese (as Mn), mg/l, Max	0.011	0.015	0.10	0.30
13.	Sodium (as Na), mg/l, Max	18.1	49.8	NS	NS
14.	Potassium (as K), mg/l, Max	4.2	11.8	NS	NS
15.	Sulphates (as SO_4^{--}), mg/l, Max	5.60	25.88	200	400
16.	Nitrate (as NO_3), mg/l, Max	4.38	13.43	45	No relaxation
17.	Fluorides (as F), mg/l, Max	0.58	0.64	1.0	1.5
18.	Arsenic (as AS), mg/l, Max	0.005	0.003	0.01	0.05
19.	Cadmium (as Cd), mg/l, Max	0.001	<0.001	0.003	No relaxation
20.	Lead (as Pb), mg/l, Max	<0.001	<0.001	0.01	No relaxation
21.	Copper (as Cu), mg/l, Max	0.003	0.001	0.05	1.5
22.	Hexavalent Chromium (as Cr^{6+}), mg/l, Max	0.005	0.003	0.05	No relaxation
23.	Selenium (as Se), mg/l, Max	<0.001	<0.001	0.01	No relaxation
24.	Silver (as Ag), mg/l, Max	0.006	0.005	0.03	0.2
25.	Zinc (as Zn), mg/l, Max	0.073	0.018	5	15
26.	Total Alkalinity, mg/l, Max	286	388	200	600
27.	Mineral Oil, mg/l, Max	<0.001	<0.001	0.5	No relaxation

NS: *Not Specified*

3.3 NOISE ENVIRONNENT

Noise is undesirable and unpleasant sound produced by the vibration of bodies or molecules of the medium and propagates as a pressure perturbation. It disturbs man's work, sleep and communication. It damages hearing and evokes other physiological reactions. Mining is the third largest industry in terms of employment and the recent trends of mechanization has changed the working environment to noisy environment leading to higher sound levels.

3.3.1 SOURCES OF NOISE

Noise produced at different levels by different equipments in the open cast mine are summarized in the **Table 11.**

Table 11: Noise Generating Mining Equipments

S. N.	Equipment / Operation	Noise level dB(A)
1.	Feeder breaker	82-100
2.	Dumpers	100-115
3.	Shovels	80-107
4.	Dozers	84-107
5.	Front End loader	83-101
6.	Electric motors, gear drivers, hopers, drilling & main pump	85-95
7.	Belt conveyer	90-92
8.	Drill	110-115

Noise level study at Kathautia Open Cast Coal Mine was carried out in buffer as well as core zone. Five noise level monitoring locations in core zone and two noise level monitoring locations in buffer zone were fixed-up and get representative values during post monsoon and winter seasons.

3.3.2 INSTRUMENTS USED

Sound level study is carried by using Mip-oy Integrated Sound Level Meter Meeting IEC-179A measuring average peak and Low values in Day and Night time.

3.3.3 RESULTS & DISCUSSION

Results are shown from **Table 12** to **17** for ambient noise levels of core and buffer zones during post monsoon and winter seasons. The average peak values at the nearby villages are found well below the standard values of 55 & 45 dB (A) for day & Night. In core zone maximum noise levels and average noise levels are also well within the prescribed limit of 75 & 70 dB (A) for Day & Night respectively.

Table 12: Noise Level in Core Zone of the Study Area (December, 2019)

Date of Sampling:		**Noise level dB(A) average**					
23.12.2019 to 27.12.2019		**Day Time**			**Night Time**		
Stn. Code	**Location**	**Min.**	**Max.**	**Average**	**Min.**	**Max.**	**Average**
N_1	Near Mine Office	36.8	69.2	54.2	32.5	60.1	46.6
N_2	Coal Face	33. 4	60.8	51. 3	30.6	55.2	42.1
N_3	Near OB dump	34.5	61.2	52.1	31.5	55.9	43.5
N_4	Stockyard	35.1	63.0	53.0	32.0	55.0	42.8
N_5	Haul Road	36.2	64.2	52.3	31.2	59.9	44.0
Standards as per CPCB		**75**			**70**		

Table 13: Noise Level in Buffer Zone of the Study Area (December, 2019)

Date of Sampling:		**Noise level dB(A) average**					
23.12.2019 to 27.12.2019		**Day Time**			**Night Time**		
Stn. Code	**Location**	**Min.**	**Max.**	**Average**	**Min.**	**Max.**	**Average**
N_6	R. R. Colony	33.1	64.8	53.3	31.6	59.1	43.0
N_7	Batsara Village	31.4	62.2	51.5	31.2	55.5	41.6
Standards as per CPCB		**55**			**45**		

Table 14: Noise Level in Core Zone of the Study Area (January, 2020)

Date of Sampling:		Noise level dB(A) average					
27.01.2020 to 30.01.2020		Day Time			Night Time		
Stn. Code	Location	Min.	Max.	Average	Min.	Max.	Average
N_1	Near Mine Office	36.2	62.3	53.6	32.7	58.6	45.9
N_2	Coal Face	33. 8	53.6	50. 1	30.3	52.4	41.0
N_3	Near OB dump	34.1	52.5	50.2	31.2	52.6	41.4
N_4	Stockyard	35.0	52.2	51.5	31.5	51.7	42.0
N_5	Haul Road	36.0	57.8	52.4	31.6	54.4	43.6
Standards as per CPCB		75			70		

Table 15: Noise Level in Buffer Zone of the Study Area (January, 2020)

Date of Sampling:		Noise level dB(A) average					
27.01.2020 to 30.01.2020		Day Time			Night Time		
Stn. Code	Location	Min.	Max.	Average	Min.	Max.	Average
N_6	R. R. Colony	33.4	60.6	52.1	31.2	50.2	42.5
N_7	Batsara Village	32.2	60.2	51.2	30.8	49.4	41.2
Standards as per CPCB		55			45		

Table 16: Noise Level in Core Zone of the Study Area (February, 2020)

Date of Sampling:		Noise level dB(A) average					
17.02.2020 to 20.02.2020		Day Time			Night Time		
Stn. Code	Location	Min.	Max.	Average	Min.	Max.	Average
N_1	Near Mine Office	36.8	68.6	55.3	32.4	62.4	46.5
N_2	Coal Face	34. 5	62.2	51. 5	30.5	54.3	42.2
N_3	Near OB dump	34.2	61.1	50.8	31.0	54.0	42.9
N_4	Stockyard	35.5	63.0	53.1	31.7	56.6	43.5
N_5	Haul Road	36.4	67.9	53.6	32.0	60.2	44.9
Standards as per CPCB		75			70		

Table 17: Noise Level in Buffer Zone of the Study Area (February, 2020)

Date of Sampling:		Noise level dB(A) average					
17.02.2020 to 20.02.2020		Day Time			Night Time		
Stn. Code	Location	Min.	Max.	Average	Min.	Max.	Average
N_6	R. R. Colony	35.5	65.2	52.8	32.4	54.3	42.9
N_7	Batsara Village	34.6	61.6	51.7	31.6	52.2	41.6
Standards as per CPCB		**55**			**45**		

4.0 SOIL ENVIRONMENT

During mining huge amount of overburden is being generated and stored as dumps. Apart from these, dust and noxious gases are continuously emitted from the mine site, which are affecting the soil quality of agricultural field of surrounding villages. To know the impact of mining on soils of surrounding area as well as effect of overburden dumping on agricultural field due to run off from soil heaps during rainy season, the soil quality of surrounding area has been evaluated with respect to physico - chemical parameters.

The physical properties of soil, which is important in its utility, are texture, Bulk density, Specific gravity, moisture content and water holding capacity. The chemical properties, which govern the best use of soil for crops and plants, are pH, N, P, K and organic matter. For assessment of soil quality, five sampling points were fixed which comprise of external OB dumps and agricultural field.

4.1 SAMPLING LOCATIONS

The soil sampling points are described below:

S_1	Agricultural soil near mine office
S_2	Agricultural soil Kajri village
S_3	Agricultural soil Batsara village
S_4	External OB dump (Old)
S_5	External OB dump (Active)

4.2 METHODOLOGY

The standard procedure was followed in sampling and all the samples were taken from 0-20 cm depth from all the sites. The sampling was done in the month of February 2020. Standard methods were followed for soil analysis and are appended in **Table 18**. The results reported are average of three replicate analyses.

Table 18: Standard Methods of Soil Analysis

Parameters	Methods
Physical Parameters	
a) Bulk Density	IS: 2720 (Part VII) - 1980
b) Water Holding Capacity	It is determined by the Keen - Raczkowski box experiment using the circular shaped boxes described by Coutts J.R.H. (1930). It is the amount of water taken up by unit weight of dry soil when immersed in water under standardized condition i.e. Weight of water held in box ---------- x 100 Weight of dry soil in box
c) Specific gravity	It is the ratio of total mass of the soil particles to their total volume excluding pore space .IS 2720 (Part III) - Section 1 & Section 2 -1980
d) Moisture content	IS 2720 (Part II) - 1973, IS 2720 (Part IX) - 1971
e) Texture	IS 1498 - 1970;
Chemical Parameters	
f) pH	It is measured by Systronics Digital pH meter using soil water ratio 1:2.5 IS 2720 (Part XXVI) - 1973
g) Organic carbon	This is measured by Walkleyand Black (1934) rapid titration methods. Organic carbon is oxidized by Potassium dichromate solution i.e. presence of concentrated sulfuric acid. The excess dichromate ion is back titrated and measured. The quality of Organic matter is calculated from the amount of dichromate ion reduced. IS 2720 (Part XXII) - 1972
h) Nitrogen	Micro Kjeldahl method is used for the estimation of total nitrogen (Jackson 1958).
i) Available Phosphorous	Olsen's (1954) methods were followed for the determination of available P in soil.
j) Available Potassium	Ammonium acetate extractable K is determined by Atomic absorption Spectrophotometer.

4.3 SOIL QUALITY

Dump and agricultural soil were collected in the month of February 2020 and had been analysed for physico-chemical parameters and results are presented in **Table 19**.

4.4. RESULTS AND DISCUSSION

4.4.1. Physical Properties of Soil Samples

The bulk density of the soil samples varies in the range of 1.12gm/cm^3 to 1.38 gm/cm^3, which indicates favorable physical condition. The particle density varies from 1.28 gm/cm^3 to 1.62 gm/cm^3. The moisture contents are found to vary from 2.25 to 5.12%. The water holding capacity also varies from 40.93% to 49.97% being maximum in the case of agricultural soil, which may be due to its high clay content.

4.4.2. Chemical Properties

All the soil samples are analysed for the chemical parameters namely pH, organic carbon, available nitrogen, phosphorous, potassium content and the results are presented in **Table 21.**

The pH of the soil samples ranged from 7.57 to 7.96, which clearly indicates that soil samples are slightly acidic in nature. Organic carbon content ranges from 0.41% to 0.78%. The available Nitrogen, Phosphorous and Potassium content of the soil samples varies from 92 to 145 Kg/ha; 5.8 to 11.4 Kg/ha and 84 to 145 Kg/ha respectively. The values indicate that the active dump materials are deficient in N, P & K that requires addition of farmyard manure, bio fertilizer and other soil amendments to make the dump suitable for revegetation. The value for agricultural soil of nearby village clearly indicates that the soil is not polluted with respect to chemical constituents.

Table 19: Physico-chemical Properties of Soil of Mine Area

S. N.	Parameters	S_1	S_2	S_3	S_4	S_5
1.	Texture	SCL	SCL	SCL	SL	SL
2.	Colour	Blackish	Yellowish Brown	Blackish	Reddish Gray	Reddish Gray
3.	pH	7.96	7.79	7.80	7.57	7.92
4.	EC (mmhos/cm)	0.55	0.51	0.44	0.32	0.38
5.	Moisture Content (%)	4.52	5.12	4.47	3.14	2.25
6.	Bulk Density (gm/cm^3)	1.16	1.18	1.21	1.12	1.38
7.	Particle density (gm/cm^3)	1.35	1.35	1.36	1.28	1.62
8.	Water Holding Capacity (%)	47.90	47.63	49.97	46.53	40.93
9.	Organic Carbon (%)	0.72	0.78	0.75	0.58	0.41
10.	Avail N (kg/ha)	145	138	140	118	92
11.	Avail P (kg/ha)	11.4	10.8	10.2	8.2	5.8
12.	Avail K (kg/ha)	138	145	134	121	84

Note: SCL – Sandy Clay Loam SL- Sandy Loam

Sampling Sites:

S_1 - Agricultural soil near mine office
S_2 - Agricultural soil at Kajri village
S_3 - Agricultural soil at Batsara village
S_4 - OB Dump soil (Old)
S_5 - OB Dump soil (Active)

5.0 CONCLUSION

On the basis of the data generated it has been found that the environmental scenario in and around mining area of Kathautia Open Cast Mine with respect to air, water and noise are well within the permissible limits.

6.0 RECOMMENDATIONS & FOLLOW-UP ACTION

The study indicates that air quality around the Kathautia Open Cast Coal Mine is found to be within the threshold limit as per the guideline of NAAQS, 2009. However, the mine is not in working during the monitoring period. Water quality of the surrounding water resources are also not found polluted by mine effluent. For the best practice of coal mining in future, Environmental Management System should always be considered with following measures:

- ✓ Frequency of spraying of water on the haul roads for controlling the dust to its minimum level may be increased.
- ✓ Regular maintenance of the heavy earth moving machines.
- ✓ Mine water collection in settling tank before its discharge.
- ✓ Garland drainage should be made around the dumps.
- ✓ Reclamation and revegetation of overburden dumps should be done to control soil erosion, denudation of agricultural land and nearby riverine system, wetlands and to improves the aesthetics of the area.
- ✓ Dumps brought under biological reclamation should not be made active.
- ✓ The mine management has been implementing, these measures to make mining operation eco-friendly in this coal mine of M/s Hindalco Industries Ltd, Daltonganj, Jharkhand.