Studies On Leachate Samples Of Overburden Materials From Some Selected Mines In Jharia Coalfield, Dhanbad, Jharkahnd, India

Arvind Kumar Rai*, Biswajit Paul**, Gurdeep Singh***
Research Scholar*, Associate professor**, Professor& HOD***
Indian School of Mines, Dhanbad, Jharkhand. India
Corresponding author: arvind_dese@rediffmail.com

Abstract: In the present period of time, the huge amount of overburden (OB) dump materials generation has posed a serious threat to the densely populated mining areas such as Jharia coalfield, Dhanbad. The overburden materials are generally loose, highly prone to rain washing, and smaller particles generated out of these get spread over the nearby surface water bodies. This paper shows the levels of trace elements leaching from overburden materials of some selected dumps sites in Jharia coalfield (JCF). It indicates the level of contamination of surface water with several trace metals present in overburden materials and do not pose any harmful effect on water bodies. [Report and Opinion 2010;2(7):59-64]. (ISSN: 1553-9873).

Key Words: Opencast mining, Overburden materials, Trace elements, Atomic absorption spectrometry (AAS), Flame photometry.

Introduction

Mining has a very important role for the development of civilization. Mining has occupied second position in industrial sector after agriculture. Overburden (OB) is the term used in mining to describe material that lies above the area of economic interest, *e.g.*, the rock and soil that lies above the coal seam. Overburden is removed during surface mining, but is typically not contaminated with toxic components and may be used to restore a mining site to a semblance of its appearance before mining began.

There are about 15 opencast, 55 underground and 18 mixed type coal mines in Jharia coalfield which have direct and visible impacts on the land regime. About 27Mt **(2007-08)** of coal produced from this coalfields, out of which about 21Mt comes from opencast mines and the remaining only 6Mt comes from old underground mines. During rainy season internal and external overburden materials are eroded at an enhanced rate. The eroded materials are deposited in nearby water bodies and nearby agricultural lands, leading to decline in productivity.

In opencast mining, extraction of coal follows removal and storage of overlying rock masses in the form of dumps. The top soil and sub soil are to be removed before blasting the rock mass. This is rare practiced in Indian coal mining areas (Kumar,N.,1997). All surface mining methods result in dramatic changes in the landscape due to large scale excavation resulting in formation of large overburden dumps and creation of huge voids in the mining sites such as These overburdens are very poor in quality in terms of plant growth and the particle size distribution in OB dump materials were found mostly above the 5.6 mm diameter range, which determines the textural class as gravel.

During the field survey of the Block II, Govindpur area, Barora area and Katras area of the JCF, it was noticed that most of the area was under various stages of coal extraction even some area is still untouched. The amount of overburden materials depends upon the mode of occurrence of the deposit. The dumped materials gradually roll down to the surrounding areas of sampling locations and it contains materials soluble in water and poured in the receiving water bodies. This may result water pollution. As the dump materials are generally loose, fine particles from it becomes highly prone to blowing by wind. These get spread over the surrounding plants and disturb their growth. The details of land use types in the opencast mining areas of JCF are shown in Table 1.

Study area

Jharia Coalfield (JCF) is situated about 260 Km North West of Calcutta in the heart of Damodar valley, mainly along of this river. The coalfield lies within the district of Dhanbad, and the town of Dhanbad is in North Eastern margin. The coalfield is named after the chief mining centre Jharia which is situated in the eastern part of the field. Figure 1 shows the location map of study area. The field is roughly sickle shaped its longer axis running northwest - southeast. The coal basin extends for about 38 km in an east west direction and a maximum of 18 km in north - south direction, and covers an area of about 456 sq.km (Fox., 1930).

The coalfield is surrounded by metamorphic rocks made up of granites, granite – gneisses, quartzite, mica schists and amphibolites. Within the basin metamorphic rocks occur only at different depths. The Barakar formation consists of coarse grained sand stones, conglomerates, shales, carbonaceous shales, silt stones, fireclays and coal seams. This is the most important formation containing coal seams and covers an area of about 210 sq km. The coal seams are generally thick and suggest slowly sinking basin (Chandra, D. 1992).Brief descriptions of the four sites are prsented in Table 2.

Materials and Methods:

Field studies have been carried out during 22th to 25th April 2008 in the JCF. Analyses of OB samples were carried out as per the standard procedure recommended by (APHA, 1985). The OB dump materials are generally exposed to atmosphere thus they are attacked by the process of natural weathering, erosion of surface fine particles, and leaching of soluble metal compounds. The leachates from overburden materials were subjected to Potentiometric and Elemental analysis. pH, Conductivity and Total dissolved solids (TDS) were determined by Cyber scan pH meter and Conductivity meter respectively. The presence of sodium and potassium was estimated using systronic Flame photometer. Trace metals were determined by using Atomic Absorption Spectrophotometer (AAS). Stock solution of sodium was prepared by dissolving 2.5416 Nacl in 1000 ml of distill water. Stock solution of potassium was prepared by dissolving 1.9 of kcl in 1000 ml of distill water (Singh et al., 2007).

Results and Discussion:

The standards of Potentiometric of overburden leachate samples are presented in Table 3 and Elemental analysis of overburden samples are presented in Table 4.The results of Potentiometric of leachate samples and Elemental analysis are presented in Table 5 and 6 respectively.

Temperature of the OB leachates was found in the range of 25.6^{0}C to 29.6^{0}C. pH is an important index of ecological of the terrestrial environment. pH of the natural waters is extremely important because it determines the solubility and chemical form of most substances. pH of the leachate of dump material found 6.22, 6.74, 6.64 and 6.27 at several sites respectively. These results reflect that the pH of all the four samples of leachates is slightly acidic in nature. It is generally observed within the permissible limits as per the *IS: 2490*. There was not very much variation in conductivity in all the four samples.TDS contents of all the samples were within the permissible limit of *IS: 2490, 1981*.

Overburden leachates from four samples were analysed for several trace elements which are presented in Table 6.Elements such as Nickel, Cadmium, Arsenic, Chromium and Selemium were found below the detection levels in the study area *(with IS : 2490)*. Iron, Cobalt, Manganese, Lead and Zinc were observed to be continuous leaching throughout the study period. The concentrations of Iron, Cobalt, Manganese, and Zinc were found within the permissible limit as per *IS: 2490*. The concentrations of Lead were found above the permissible limits as per *IS: 2490 or 10500*. The concentrations of sodium and potassium were also found within the permissible limits.

Table 1 Distribution of land use types in the opencast mining zone, JCF

S.No	Land use type	Area in sq .km	Area in %
1	Settlement	23.79	22.87
2	Agricultural land	2.32	2.23
3	Plantation	2.65	2.55
4	Sparse vegetation	0.45	0.43
5	Degraded vegetation	25.98	24.98
6	Barren land	28.06	26.98
7	Tanks/Ponds	1.22	1.17
8	Stream/River	1.47	1.41
9	Quarries	12.39	11.92
10	Overburden dumps	5.67	5.46
Total area		104.0	100.0

Ref: Raju EVR, 1999

Table 2. Sampling sites along with code

S.No	Sites	Site code
1	Block II area	OB_1
2	Barora area	OB_2
3	Govindpur area	OB_3
4	Katras area	OB_4

Table 3. Standard of Potentiometric of leachates samples

S.No	Parameters	IS:2490,1981	IS:2490,1981	IS:10500
1	Temp	40	....	..
2	pH	5.5 -9.0	5.5 -9.0	6.5 - 8.5
3	Conductivity	....	..	..
4	TDS	2100	2100	500

Where,

IS: 2490, 1981: Specification for inland surface water.

IS: 2490, 1981: Specification on land for irrigation.

IS: 10500: Specification for drinking water.

Table 4. Standard of Elemental analysis of leachate samples.

S.No	Parameters	IS:2490 (for s/w)	IS:2490 (for Irrigation)	IS:10500 (d/w)
1	Copper	3	...	0.05
2	Zinc	5	...	....
3	Iron	3	...	.....
4	Nickel	3	...	0.3
5	Cobalt	.....	..	.....
6	Cadmium	2	...	0.01
7	Manganese	.....	....	0.01
8	Arsenic	0.2	0.2	0.05
9	Chromium	2	....	0.005
10	Lead	0.1	....	0.01
11	Selenium	0.05	....	....
12	Sodium	...	60	...
13	Potassium	.....	....	.....

Table 5. Potentiometric analysis of overburden leachate samples

Parameters	OB_1	OB_2	OB_3	OB_4
Temperature (^oC)	25.6	27.8	26.3	29.6
pH	6.22	6.74	6.64	6.27
Conductivity (millimos/cm)	0.51	0.78	0.67	0.44
Total Dissolved soilds (ppm)	257	374	368	336

Table 6. Concentration of trace elements in leachate samples (in ppm).

Parameters	OB_1	OB_2	OB_3	OB_4
Sodium	15	17	11	22
Potassium	6	7	5	8
Iron	0.043	0.45	0.38	0.56
Nickel	BDL	BDL	BDL	BDL
Cobalt	0.38	0.34	0.27	0.042
Cadmium	BDL	BDL	BDL	BDL
Manganese	0.037	0.073	0.083	0.034
Arsenic	BDL	BDL	BDL	BDL
Chromium	BDL	BDL	BDL	BDL
Lead	0.45	0.36	0.73	0.62
Selenium	BDL	BDL	BDL	BDL
Copper	BDL	BDL	0.006	BDL
Zinc	60.23	70.02	50.034	80.245

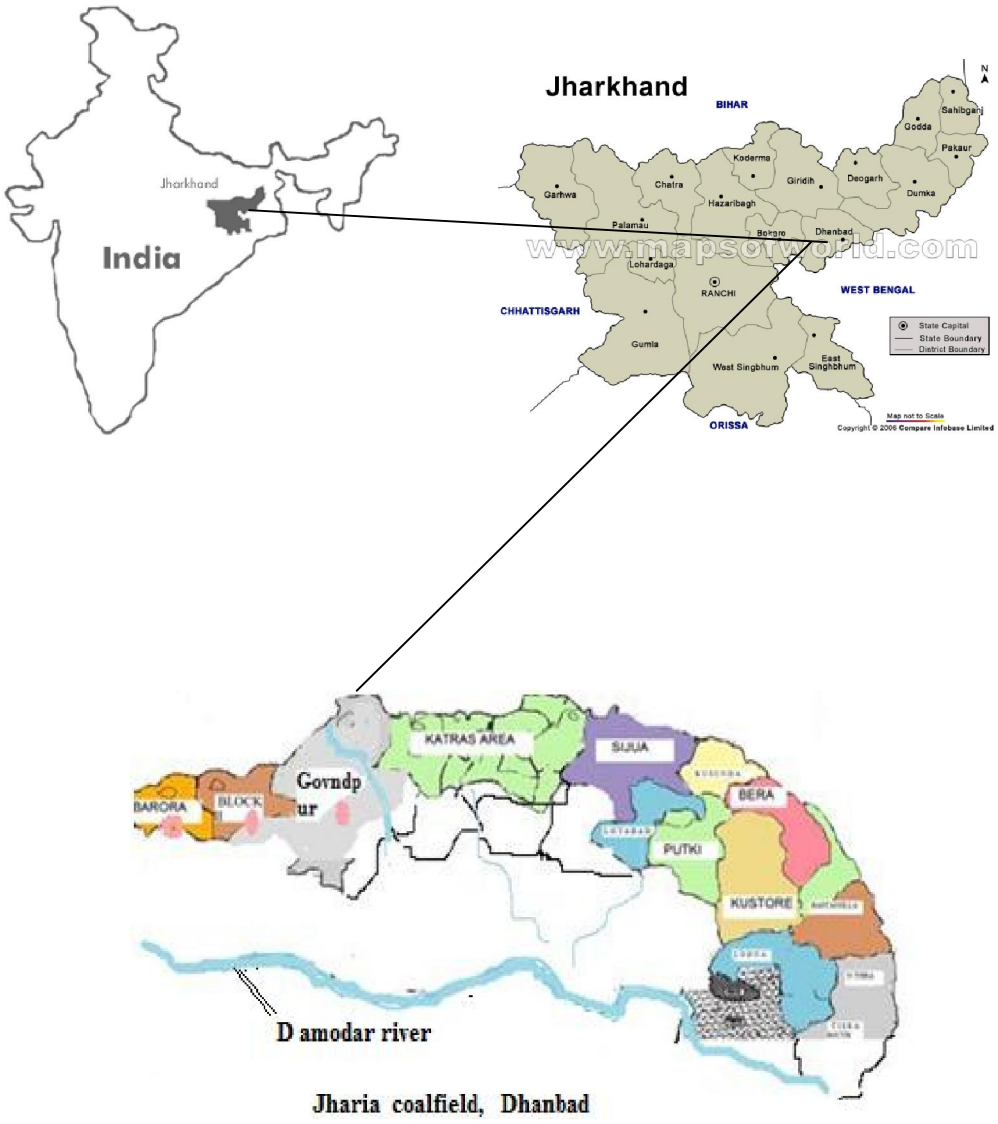

Figure 1.Map of study area Jharia coalfield *(Not in scale)*

Conclusion

On the basis of the study of the leachates samples of overburden materials in Jharia coalfield the following conclusions are drawn:

The dump materials have different type of rocks and its composition were the main sources of trace metals in the leachates samples. But the concentrations of trace elements were found within the permissible limits as per IS: 2490. Thus, it can be concluded that leachates of overburden samples do not pose any major environmental problem regarding its backfilling, in opencast mines or abandoned mines in JCF. Disposal of leachates do not pose any adverse impact on the water bodies. Keeping in mind, all

leachates from overburden materials containing trace elements should be guided to sedimentation tanks or ponds for settlement of suspended solids along with toxic elements before discharge of water into nearby rivers.

Correspondence to

Arvind Kumar Rai, Research Scholar.

Department of Environmental and Science and Engg

Indian School of Mines, Dhanbad,

State: Jharkhand. India.

Phone: 0326-2296624.

Cellular phone: 8877145176

Email: arvind_dese@rediffmail.com

Date: 25/07/2010.

References:

Nikhil K..Vegetational Succession on Coalmining Overburden for Sustainable Ecological development, PhD thesis, ISM. Dhanbad 1997

Raju EVR. Geo Strategies of Land use planning in JCF, using Remote Sensing methods. M.Tech thesis, ISM, Dhanbad. 1999

Fox CS. The Jharia coalfield, Memoir G.S.I. Vol. 56. 1930

Chandra D. Jharia Coalfield, Mineral resources of India, GSI, Bangalore1992

MoEF Project. An assessment of overburden dump rehabilitation technologies adopted in CCL, NCL, MCL, and SECL mines, submitted to MoEF, Delhi. 2003

APHA. Standard Methods for Examination of Water and Wastewater. American Public Wealth Association, Washington D.C. USA. 1985

Singh G, Kumar R, & Kumar P. Assessment of Trace Elements Leaching of Coal Combustion Residues from Bokaro thermal Power Station, JESE, Vol ,49, No 1,pp 77 -86. 2007.

Banerjee S.P, & Singh G. Problems of water pollution in mining areas issues related to its protection and control, Proceedings of environmental policy issues, Organised by MGMI, ISM, Kolkata. 1993.

Ghosh R Land use in Mining areas of India**.** Envis Monograph No.9, CME, ISM, Dhanbad. 2002.

Singh G, Saxena N.C., Sarkar B.C Mining Management Environment Manual, ISBN: 81-7233-366-8. 2005

De A. K. Environmental Chemistry, Willey Eastern Limited.1984

IS: 2490.Tolerance Limits for Industrial effluents, New Delhi, 1981

7/5/2010