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Assessment of Underground Water Contamination Due to Early Coal Mining Activities in Nigeria

Garba T., [1*] Babanyara Y. Y., [2] Ibrahim D.B[1]., Lot I[1]
1, Department of Environmental Management Technology
Abubakar Tafawa Balewa University Bauchi, P.M.B. 0248 Bauchi-Nigeria
2, Department of Urban and Regional Planning,
Abubakar Tafawa Balewa University Bauchi, P.M.B. 0248 Bauchi-Nigeria

Abstract
This paper examines the level of mining activities impairment on underground water quality. Five samples were obtained three (3) from bore hole waste, one from open well and one from nearby stream. The samples obtained were analyzed based on Physical, Biological and Chemical Parameters. The result shows most of high concentration of chemical elements impairing on water quality as a result of mining activities such as Nitrate, Chloride, Phosphate, Cyanide, Fluoride, Iron, Manganese etc. Additionally the bacteriological analysis of these water samples revealed the concentration off *e coli* bacteria in the most boreholes, well, and the stream. The paper concluded that even though borehole were provided to augment the water supply for communities consumption but consideration was not given to streams where waste water from the mining site are normally drained into because it is use by plant and animals. There is therefore the need to treat the water before discharge into the stream.
Keywords: Contamination, Mining, Parameters, Samples, Underground water,

Introduction

All life depends on land, for people construct homes on land, food is cultivated on land, and when people ultimately die their remains are committed to land. Usually, life's basic needs are expressed to be food, clothing and shelter but it is true to assert that there is only one essential or basic need of life and that is land because food, clothing and shelter are entirely derived from land. (Mohammed 2004 and Ladan 1997). Water is an essential commodity to living things and non living things and it is important in all aspect of human life. Water is used for domestic, industrial and other purposes. Chemically, the combination of oxygen and hydrogen forms water. As water penetrates through the ground surface to the subsurface as groundwater, impurities get into it. The public most especially the rural dwellers consume well water without due consideration of its chemical and biological composition. Perhaps this may be due to severe water problems in parts of the rural area. The quantities of water are just as important as its quality Todd, (1959). History revealed the inception of ground water investigation by the geological survey of Nigeria started in 1926, the quality of portable water was not taken seriously until Dufreez and Barber's 1965 investigation of ground water quality in the northern parts of Nigeria

The exploitation of the mineral resources results in the environmental degradation with large scale consequences. Although mining activities directly affects a relatively limited area of terrestrial land, its impacts on the environment, as well as on public health, may be found at greater distances from the source and for a long period Ahanger *et. al,*. (2014) Boni *et. al,*. 1999 and Balistrieri., *et. al,*. 1999

Coal mining have disastrous impacts on the Environment. Compared to the high price of oil and natural gas, coal even though very cheap but appearances may be deceiving. The true costs of conventional coal extraction and use are significant. The conventional coal fuel cycle is among the most destructive activities on earth, threatening our health, fouling our air and water, harming our land, and contributing to global warming.

Mining is a common practice in Nigeria, the problem with mining activities in the country, however, is the inattention of the miners and the government to proper mining practices which makes life difficult for the people. And many people because of their low level of education do not know their environmental obligations under the Minerals and Mining Act, and that the adherence to best global practices in mining is a vital tool for the promotion of sustainable growth in the industry Ifeanyi 2010, Although mining provides a variety of socio-economic benefits but its environmental costs, if not well handled can be massive in terms of land conversion and degradation, habitat alteration, water and air pollution Adekoya, 2003. In Africa, the mining sector is thought to be the second largest source of pollution after agriculture; the sector is resource intensive and generates high concentrations of waste and effluents (Babagana, et. al. 2012 and Aigbedion, and Iyayi, 2007). Mining from exploration to the closing stage has a serious impact on the environment. This impact can be direct through the value chain activities, prospecting exploration, site development, ore extraction, mineral dressing, smelting, refining/metallurgy, transportation, post mining activities and indirectly through the impact of the degradation on the socio-cultural development of communities. In general, degradation arising from mining includes; air pollution, water pollution, land and forest degradation, noise pollution, solid and liquid waste

disposal of toxic substances, as well as socio-cultural problems such as health complication, conflicts, alcoholism, communal clash and inequality (Babagana, *et. al*. 2012 and Twerefou, 2009)

The problems caused by mining activities are land degradation, disposal of over burden, deforestation, washing rejects, subsidence, water pollution due to wash off, discharge of mine water, acid mine drainage, coal washing operation, air pollution due to release of gases and dust, noise pollution, mine fires, damage to forest flora and fauna, wildlife habitat destruction and occupational health hazards (Singh *et. al.*2011 Ahanger *et. al,.* 2011)

Methodology

Sample was collected in the Maiganga village coal mining site. The Samples were collected from existing boreholes, hand dug well, and stream water. The first sample was taken at 165 meters from the mining site. The second was 245 meters away from the mining site and the third borehole was 302 meters away from the mined, the fourth sample was taking from open well at about 250 meters from the mining site. While the fifth sample was taken at the stream which is where the mining company drained its waste water.

Water samples were collected with the aid of 50ml capacity sample bottle and property labeled. Representation sample of the hand dug well was collected by lowering a sling or rope tight to the collected and release to the bottom of the well, mixed the water thoroughly before pulling the collector out. Part of the collected water was used to rinse the samples bottles out two or three times with the water being collected, before the bottles were filled and tightly covered.

The water samples were then analyzed. The analysis include the determination of physico-chemical and bacteriological parameters. The physical include:- temperature, total hardness, turbidity, total suspended solid, electrical conductivity etc. The chemical includes: - Calcium, magnesium, pH, alkalinity, chloride, fluoride, chromium, cyanide, nitrate, nitrite, lead, iron, sulphate etc. Bacteriological such as *E. coli*, fecal coli form and total coli form.

Results

Total of five water samples were collected in the study area, three of which are from the boreholes water samples, one which is from the Open well and one from the mine water (Nearby Stream) samples linking to the surface water in the stream. The sample were analyze three times at three weeks interval to ensure check of the analyse result. The mean results of the analysis for the parameters were given in the tables and figure.

Table 1*: **Mean Result of Physical Parameter***

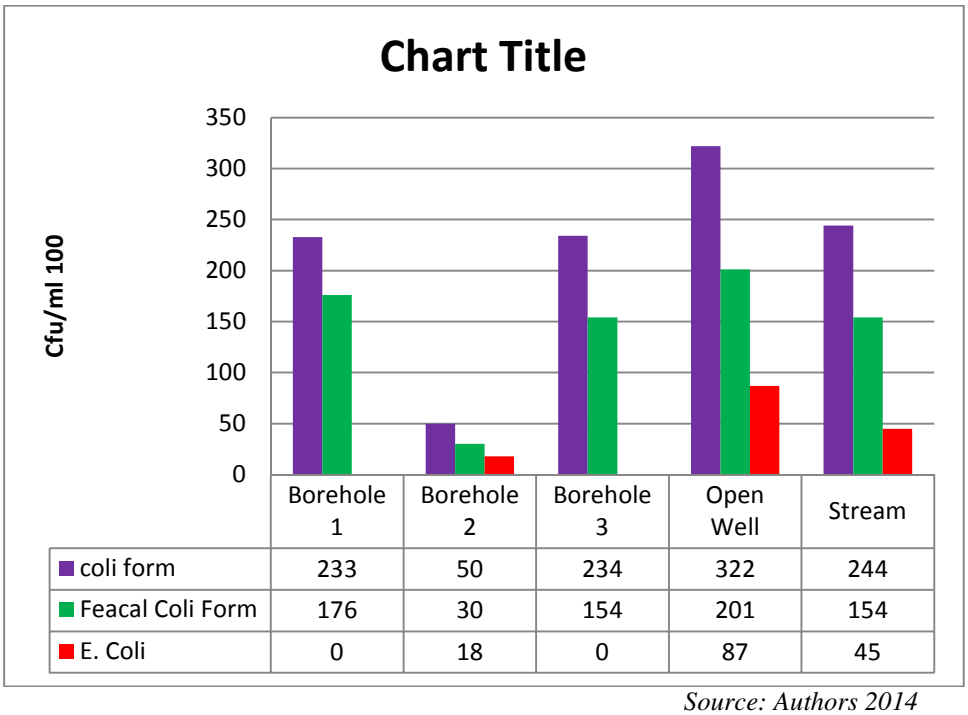
Parameter	**units**	**Water samples**					
		Borehole			**Open well**	**Mine Drain**	**NSDWQ**
		1	2	3			
Temperature (^{0}C)	Mg/l	26.6	26.5	26.5	26.5	26.5	
Colour	*Pt. co*	*332*	*322*	*54*	*45*	*8*	*15*
Appearance		Obj	obj	obj	Obj	unobj	Unobj
Turbidity	NTU	33	98	32	12	23	5
Electrical Conductivity	Us/ cm	155	93.3	200	300	434	1000
Total hardness	Mg/l	50	120	65	120	248	150
TSD	Mg/l	76.9	46.5	100	149	217	500

Source: Authors 2014

Table 2*: Mean Result of Chemical Parameter*

Parameters	Unit	Water Samples					NSDWQ
		Borehole			Open Well	Stream	
		1	2	3			
Calcium ca2+	Mg/l	32	87	67	74	143	70
Magnesium mg2+	Mg/l	1.45	2.11	0.32	2.23	21.04	0.20
Total iron, fe2+	Mg/l	12.02	10.8	20.2	1.4	4.30	0.3
Copper, cu^{2+}	Mg/l	0.2	0.54	0.00	0.12	0.06	1.0
Fluoride,	Mg/l	1.42	0.35	0.43	1.02	0.21	1.0
Total alkalinity	Mg/l	40	55	52	50	75	100
Zinc, zn^{2+}	Mg/l	1.2	1.3	0.05	2.37	0.02	3
Nitrate, No_3	Mg/l	75	87	89	13	155	50
Nitrite, No_2	Mg/l	1.43	0.11	032	1.05	1.02	0.02
Manganese, Mn^{2+}	Mg/l	1.24	0.54	0.0	0.0	0.0	0.05
Lead, pb^{2+}	Mg/l	0	0	0	0	0	0.001
Sulphate, So_4	Mg/l	20	65	40	36	50	100
Chloride, Cl	Mg/l	14	16	32	21	9.0	250
Chromium, Cr^{6+}	Mg/l	5.33	3.23	0.00	0.00	0.00	0.05
Barium, Ba^{2+}	Mg/l	0.54	0.07	3.04	0.00	0.00	0.005
Phosphate	Mg/l	0.00	2.8	0.00	0.00	0.00	10
Cyanide	Mg/l	0.73	0.24	0.008	0.004	0.032	0.001
pH		7.7	7.0	7.1	7.1	6.9	

Source: Authors 2014



Source: Authors 2014

Fig. 1*: Mean Result of Microbial Parameter*

Discussions

From the ranged of color values of the water samples obtained, it clearly indicated are presence of highly dissolved substances such as organic and inorganic in the water and this can be attributed to the interference of the mining activities. However due to their depthless three boreholes and open well has high concentration of contaminants resulting from the mining activities. The appearance is objectionable for the three boreholes and the open well and unobjectionable for the mine drain. The taste objectionable for borehole 3 and the mine drain.

The value indicated there is concentration of calcium in open well and stream the result also shows high concentration of magnesium, iron, fe^{2+}, Nitrate, No_3, Nitrite, No_2, and Cyanide CN in all the samples. The result shows low concentration of Copper, Cu^{2+}, Zinc, Zn^{2+}, Sulphate, So_4 and Chloride, Cl in all the samples. But in

fluoride and Chromium, Cr^{6+} the result show high concentration in only two. Result also shows Barium, Ba^{2+} is concentrated in borehole 1, 2 and 3.

Although microbial contaminants are not sourced from mining activities but the paper assess it so as know how safe the water is for public consumption. Therefore the result shows that there is high concentration of *coli form* and feacal coli form count even though it is low in one of the sample. While *E. coli* is only concentrated open well and mine drain probably due to their shallow nature.

Conclusion

The Result of analysis obtained show clearly that the major mining contaminants such as Nitrate, Chloride, Phosphate, Cyanide, Fluoride, Iron, Manganese impair with the water quality of the area. It also shows that the stream water is contaminated for uptake by flora and can easily treaded into the blood stream of human system. Although bore hole were provided to arguments water supply to the communities but consideration was not giving to the water discharge to streams which is used by plant and animal and sometimes for drinking. There is therefore the need to treat the mine water first before discharge into the stream.

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