

IMPACT ASSESSMENT OF INDUSTRIAL EFFLUENTS ON WATER QUALITY OF CHALLAWA RIVER IN KANO-NIGERIA

*Yakasi.S.M¹, Kiyawa. S.A², Abba. H³

¹Department of Chemistry, Federal University Dutse, Jigawa State, Nigeria.

²Federal College of Education Technical Bichi, Kano.

³Department of Chemistry, Ahmadu Bello University Zaria

*Corresponding author's Email: saminum@yahoo.co.uk

ABSTRACT

Challawa River is receiving industrial effluents as a point source. The water quality of the river upstream and downstream after the point of effluent discharge was assessed with a view of determining the effect of industrial effluent on the water quality of the river. The water samples were analyzed for hydrogen ion concentration (pH), Dissolved oxygen (DO₂), electrical conductivity (EC), total dissolved solids (TS), Pb, Cd, Cu, Zn, Phenol, Sulphide, Biological oxygen demand (BO) and Chemical oxygen demand (COD). The mean values for the parameters in the upstream were 7.8, 3.9, 425, 103.8, 0.019, 0.0023, 0.09, 0.14, 0.0015, 0.027, 0.003, 21.3, and 42.8mg/l. While those for the downstream were 8.02, 1.63, 730, 243.5, 0.127, 0.017, 1.5, 2.8, 0.065, 0.32, 0.07, 74 and 305mg/l. It was concluded that the Challawa River is adversely affected and impaired by the discharge of industrial effluents and recommendations were drawn for the industrialists, policy makers and the populace towards alleviating the negative impacts.
KEYWORDS: *Challawa River, Industrial effluents, Water quality and pollution.*

INTRODUCTION

Environmental pollution is one of the problems presently facing developing countries and several efforts are being vigorously pursued to control it. Business and industry play a crucial role in the socio-economic development of a country. However, industrial development is the main cause of depletion of natural resources and degradation of environment (Abdullahi, 2004). Industries generate wastes, which can be damaging to water, air, land resources and quality of life. Contaminated air, soil and water from industries are associated with heavy disease burden (WHO, 2002) and this could be part of the reasons for the current shorter life expectancy in the country (WHO, 2003) when compared to the developed nations. Some heavy metals contained in these effluents are known to be carcinogenic (Tamburlini *et al.*, 2002).

In advanced countries, environmental monitoring agencies are more effective and environmental laws are strictly enforced. General environmental quality monitoring is compulsory and the monitoring of the quality of water resources is done on regular basis (Neal and Rabson, 2000; USGS, 1995; USEPA, 1995).

As a result any abnormal change in the environment or water quality can easily be detected and appropriate action taken before the outbreak of epidemics. The case is quite the opposite in many developing nations, environmental laws where they exist are rarely observed.

Challawa River, is the second largest river after Kano River in Kano State. It meets Kano River at Tamburawa, some twenty kilometers from Kano city and joined River Hadejia. It serves as the major source of drinking water for the Kano metropolis and its neighbouring communities. It

is subjected to industrial effluents discharges from industries sited along its bank. Sewage and municipal waste input, surface runoffs and soil erosion may also contribute to pollution of the river along its course. Industries that discharge into the river include confectioneries, pharmaceuticals, rubber, leather, textiles and food processing factories as well as some small agro-allied industries such as soap manufacturing firms and abattoirs. Untreated waters from these industries are often discharged into the river leading to high chemical oxygen demand, biological oxygen demand, nitrate electrical conductivity, copper, zinc and low dissolved oxygen.

Human settlements, such as Panshekara, Zawachiki, Challawa, Yandanko, Kumbotso and Tamburawa are found along the river bank, which has encouraged the communities to farm during heavy rains, the farmlands are flooded, resulting in washing of plant debris, pesticides and fertilizer residues into the river, nutrients, such as phosphates and nitrates which are constituents of many fertilizers usually increase algal growth, leading to eutrophication.

MATERIALS AND METHODS

Sampling Technique

Effluents from point of discharge, upstream and downstream were collected as composite sample at 30minutes interval over a period of five hours. At each times of effluent collection, two separate sets of samples were collected, one for metals and the second for the determination of other physicochemical parameters. The sample was stored in a clean polyethylene / glass bottles that have been pre-washed with nitric acid and thoroughly rinsed with de-ionized water.

Table 1: INSTRUMENTS

SN	EQUIPMENT	MODEL	MANUFACTURER	AGE
1	Spectrophotometer	DR/2010	HACH	3YRS
2	COD digestion reactor	4560	HACH	1YR
3	Conductivity meter	CO 150	HACH	1YR
4	PH meter	CO 150	HACH	2YRS
5	Dissolved oxygen meter	9071	JANWAY	3YRS
6	Water sampler	1520 C20	WILDOC	3YR
7	Electronic balance	WA 210	Adam Equip	1YR
8	Digital Titrator	WA 210	HACH	1YR
9	Incubator	OV 160C	Gen. Lab.	1YR
10	Dessicators	OV 160C	Gen. Lab	2YR
11	Heating mantle	1010235	Electro-thermal	2YRS
12	Water de-ionizer	B114	Elegacan	1YR

DETERMINATION OF pH and CONDUCTIVITY

The water chemical analysis was done using standard analytical method of water analysis (Trived and Goyal, 1986; APHA-AWWA-WPCF, 1985). Non-conservable parameters such as temperature, pH and electrical conductivity (EC) were determined at the time of sampling in the field. The pH of the sample was measured with pH meter that has been previously calibrated with buffer solutions and conductivity meter calibrated with potassium chloride solution.

DETERMINATION OF DISSOLVED OXYGEN (DO)

Dissolved oxygen (DO) was determined by Winkler's titration.

DETERMINATION OF TOTAL SOLIDS (TS)

Total solids (TS) were determined gravimetrically by evaporating a known volume of effluent to dryness in pre-weight crucible on a steam bath at 105°C.

DETERMINATION OF CHEMICAL AND BIOLOGICAL OXYGEN DEMANDS (COD, BOD)

Chemical oxygen demand (COD) was determined by dichromate digestion method while biological oxygen demand (BOD) was determined by dilution method.

DETERMINATION OF HEAVY METALS

Heavy metals (Cr, Cu, Zn, Pb and Cd) were determined by digesting a known volume of effluent sample with analytical grade HNO₃. The digested effluent was filtered into 20ml standard flask and made up to the mark with distilled-de-ionized water and stored in a nitric acid pre-washed polyethylene bottle in the refrigerator prior to chemical analysis. The effluent extracts were analyzed for the metals by HACH spectrophotometer. Each sample was analyzed in triplicate and average of the results reported. General laboratory quality assurance measures were always observed to prevent sample contamination and instrumental errors.

The water used throughout the experiment was doubly distilled in an all glass distiller before it was de-ionized. Wavelengths setting of the spectrophotometer used was done daily by standard instrumental procedure and other equipment used were always calibrated against reference standard.

RESULTS AND DISCUSSION

Challawa River was clear before the point of the discharge of the effluent. The river became gray black, stagnant with offensive odour.

TABLE 2

LEVELS OF PHYSICOCHEMICAL PARAMETERS AND HEAVY METALS AT VARIOUS SAMPLING POINTS OF CHALLAWA RIVER

SAMPLING POINT	DISTANCE (m)	PH	DO ₂	EC	TS	Pb	Cd	Cu	Zn	Cr	S	Phenol	BOD	COD
UPS4	1000	7.10	5.3	200	80	0.005	0.00	0.06	0.05	0.00	0.02	0.001	18.00	20.00
UPS3	750	7.20	4.3	250	100	0.008	0.002	0.08	0.10	0.00	0.02	0.002	20.00	35.00
UPS2	500	7.80	3.5	500	110	0.015	0.003	0.10	0.15	0.002	0.03	0.004	22.00	50.00
UPS1	250	8.20	2.5	750	125	0.025	0.004	0.12	0.25	0.004	0.04	0.005	25.00	66.00
Average (UPS)		7.85	3.9	425	103.8	0.019	0.0023	0.09	0.14	0.0015	0.027	0.003	21.30	42.8
		±1.10	±2.80	±550	±45.0	±0.20	±0.004	±0.06	±0.25	±0.004	±0.02	±0.004	±7.0	±46.0
STD		0.52	1.2	253	18.9	0.02	0.0017	0.026	0.085	0.0019	0.095	0.0018	2.98	19.75
EFF	0	9.70	0.0	2415	460	0.37	0.038	3.80	10.1	0.15	1.0	0.18	140	850
APD1	250	9.50	0.0	1850	350	0.25	0.025	2.40	6.20	0.12	0.75	0.15	105	450
APD2	500	9.00	0.0	1600	320	0.22	0.024	2.20	5.20	0.10	0.65	0.12	95	425
APD3	750	8.60	0.0	1300	290	0.19	0.022	2.00	4.40	0.09	0.55	0.09	90	400
APD4	1000	8.20	0.0	100	260	0.16	0.02	1.80	4.00	0.08	0.45	0.08	85	370
APD5	1250	8.00	0.5	750	230	0.13	0.018	1.60	3.80	0.07	0.35	0.07	80	360
APD6	1500	7.80	1.0	500	210	0.10	0.016	1.40	3.20	0.06	0.25	0.06	75	320
APD7	1750	7.50	2.0	350	205	0.07	0.014	1.20	2.80	0.05	0.15	0.05	70	280
APD8	2000	7.30	3.0	250	200	0.06	0.012	1.00	2.40	0.04	0.10	0.04	60	220
APD9	2250	7.20	4.80	200	100	0.05	0.101	0.80	1.80	0.03	0.08	0.02	45	10
APD10	2500	7.10	5.5	180	180	0.04	0.008	0.60	1.20	0.01	0.04	0.01	35	70
Average (DWS)		8.02	1.63	70	2453.5	0.127	0.017	1.5	2.80	0.065	0.32	0.07	74	05
STD		±2.40	±5.5	±1670	±170	±0.21	±0.017	±1.80	±5.90	±0.11	±0.71	±0.4	±70.0	±380
		0.808	2.217	6.54	58.88	0.075	0.0058	0.606	2.01	0.035	0.27	0.043	22.08	124.3

UPS= Upstream

DWS=Down stream

Table 2 shows that the average levels of pH, DO₂, EC, TS, Pb, Cd, Zn, Cr, S, Phenol, BOD and COD with distance at the sampling points.

pH-The PH levels upstream for Challawa River ranged between 7.10 to 8.20 with average level of 7.58. The PH values were normal for unpolluted fresh water (Kudiyartseva, 1999; Chemyarkayo et al., 1993). After the discharge of effluent at APD1 the PH value was 9.5

DO₂ In Challawa River, the water upstream was rich in DO₂ with levels ranged between 2.5 to 5.3mg/l. This level could adequately sustain aquatic life. After the point of discharge the DO₂ level was not detected until at ADP5 and the level was 0.5mg/l.

Depletion of DO₂ downstream was due to the enormous amount of pollutional loads which require high levels of oxygen for chemical oxidation, decomposition or breakdown.

EC- Challawa River has an average level of EC of 730us/cm downstream. High levels of EC could be attributed to high level of conducting species such as chloride, phosphate, nitrate and heavy metals present in the effluents.

Total Solid (TS) - The levels of Ts upstream in Challawa River was 103.8mg/l while the levels of Ts downstream were 243.5mg/l.

Heavy metals- In Challawa River the levels of Pb, Cd, Cu, Zn and Cr upstream were of average levels of 0.019, 0.002, 0.09, 0.14 and 0.0015mg/l respectively, while the average level for the same metals downstream were 0.127,

0.017, 1.5, 2.8 and 0.065mg/l respectively. Low levels of these metals upstream before the point of discharge with corresponding high levels downstream after the point of effluent discharge in many rivers has also been reported elsewhere (Gasparon and Burgess, 2000; Tsarewa et al., 1999; Kashmir and Ivanova, 1997). Water downstream is used for irrigation of many vegetables and other food crops along the river because of its high nutrient contents.

CONCLUSION

The results of the study revealed that the water qualities at Challawa River was adversely affected and impaired by discharge of industrial effluent. The levels of parameters downstream were significantly elevated than the corresponding level upstream. The quality of the industrial effluent was poor.

Recommendations

Effluents should be treated to safe level by industries before being discharged to the rivers or streams.

Nigerian Environmental Protection Agency and other Environmental regulatory bodies should be more aggressive and effective in environmental monitoring assessment and enforcement of environmental laws and regulations.

People should desist from the use of effluents or contaminated water for irrigation of any kind.

REFERENCES

- Abdullahi, A. (2004): Report of committee on wastewater treatment plant at Sharada, Challawa and Bompai industrial estates, Kano, P1-10.
- APHA-AWWA-WPCF (1985). Standard methods for the examination of water and waste water. APHA-AWWA-WPCF. Washington DC.
- Chernyavskaya, A.P; Denisova A.I.(1993).Chemical composition of Denibe River. *Water Resources* 20(4),440-446.
- Gasparon, M; and Burges, J.S.(2000).Human impacts in Antarctica: Trace element Geogchemistry of fress Lakes in the larsemann Hill, East Antaectica, *Environmental geology* 39 (9), 963-976.
- Kudryavtseva, L.P.(1999). Assessment of Drinking water quality in the city of Apati. *Water Resource* 26(6), 659-665.
- Kashim, V.K and Ivanov, G. (1997). Nickel in Natural Waters of Transbaikalia. *Water Resources*, 26(6), 659-665.
- Neal, C. and Robson, A.J. (2000): A summary of river water quality data collected within the land ocean interaction study. Care data for Eastern UK Rivers draining to the North Sea. *Science of the total environment*. 251/252, 585-5.
- WHO (2000): Water pollutants biological agent, dissolved chemical, non-dissolved chemical sediments, heat, WHO CEHA AMMAN JORDAN, World Health report 2003: shaping the future, World Health Organization, 1211, Geneva 27, Switzerland.
- WHO (2002) Water Pollutants: Biological Agents, Dissolved Chemicals, Non dissolved Chemicals, Sediments, Heats, WHO CEHA, Amman, Jordan.
- WHO (2003): The World Health Report 2003. Shaping the future, World Health Organization, 1211, Geneva 27, Switzerland.
- Tamburlini, G, Ehrestein, O.V. and Bertollin, R. (2002). Childrens Health and Environment: A Review of Evidence, in : Environmental Issue Report No. 129, WHO/European Environment Agency, WHO Geneva, pp 223.
- Trivedi, R.K and Goyal, P.K. (1986). Chemical and biological methods for water studies. Environmental Publication. pp 123.
- Tsareva,S.A; Chesnokova,T.A; Grinevich, V.I, Kestriv, V.V.(1999). Forms of metals occurance in Water and Bottom deposits of the Uvod Reservoir. *Water Resources* 26(1), 62-66.
- United States Environmental Protection Agency (USEPA) (1995). 1994 National Water Quality Inventory Report, pp 97.
- United States Environmental Protection Agency (USEPA) (1996). Environmental indicators of Water Quality in the United States. pp 841.
- United States Geological Survey (USGS) (1995). Water Used in United States.