ASSESSMENT OF EFFLUENT FROM HERBAL MIXTURE INDUSTRY ON THE PHYSICO- CHEMICAL PARAMETERS OF NEARBY WELL WATER

Liasu M. Ayotunde* and Okoya A. Adetutu
Institute of Ecology and Environmental Studies,
Obafemi Awolowo University, Ile-Ife, Nigeria

*Correspondence author email: liamayotunde77@gmail.com

INTRODUCTION

- Human activities such as industrialization alter water quality by polluting the environment.

- Active industrialization and urbanization coupled with commercial activities in Nigeria has tremendously increase effluent (Ajayi and Osibanjo 1981).

- Herbal medicine has been household products in Nigeria.

- Herbal pharmaceutical effluent has pollution load of organic and inorganic compounds due to the host of several herbs used in the process of various herbal formulations.

INTRODUCTION CON'TD

- Improper disposal of industrial wastes can result in a wide variety of contaminants being introduced to the groundwater (Akastal, 1989).

- Contaminants such as heavy metals, volatile and semi-volatile organic compounds, highly acidic or basic solutions, solvents and nutrients have been reported in literature for groundwater .

- However, at Surulere Community in Osogbo, alternative water sources for livelihood activities apart from rain water is hand-dug wells.

STATEMENT OF RESEARCH PROBLEM

- Effluent from an herbal mixture industry is being discharged into an open drainage close to some wells in Surulere area of Osogbo. Water from the wells are coloured indicating possible effluent pollution. There is therefore the need to assess the effect of the effluent on the water quality, hence this study.

Objectives of the Study

The specific objectives of the study are to

- determine the physico-chemical parameters of the effluent discharge from herbal mixture industry;

- determine the physico-chemical parameters of the water from the wells located in the area around the effluent open drainage; and

- determine the impact of the effluent on the well water.

Expected Contribution to Knowledge

- The study will provide information on the impact of the industrial effluent on the water quality in the study area.

METHODOLOGY

- This study was carried out at Surulere Community (Kasmo Area), Oke-Baale, Osogbo, Osun State Southwestern Nigeria. The descriptions are as shown in the Table 1 below.

- The untreated herbal mixture effluents were collected in October and December, 2013 and seven well water samples were collected in July, August and December, 2013 and January, 2014.

Table 1a: Location of sampling points and their description

S/N	Station ID	Well distance relative to drainage
1	W_1	2.7 m (Same side as effluent drainage)
2	W_2	> 200 m (Off effluent drainage)
3	W_3	3.9 m (Same side as effluent drainage)
4	W_4	1.3 m Same side as effluent drainage
5	W_5	19.0 m (Same side as effluent drainage)
6	W_6	8.4 m (Other side of effluent drainage)
7	W_7	13.0 m (Same side as effluent drainage)

W_1 - W_7 = Well 1 to Well 7

METHODOLOGY

- Water collecting device used by the residents was employed to obtain water samples from the hand-dug wells, while water from pump fitted wells were collected directly from the taps' head.

- Separate samples were collected in DO and BOD bottles, and two and half litres' plastic sampling bottles for other parameters. Temperature was determined *in-situ*, DO was fixed on site while other physico-chemical parameters were determined in the laboratory.

METHODOLOGY

Table1b: Showing parameters and methods

PARAMETERS	METHOD / INSTRUMENT	REFERENCE
Dissolved Oxygen (DO), Biological oxygen demand (BOD)	Titrimetry (Winkler Method)	Golterman *et al.* (1978)
Air /Water Temperature	Thermometer	APHA (1995)
Acidity/Alkalinity (Carbonate)	Titrimetry	Golterman *et al.* (1978)
pH	Lovibond comparator/ pH meter	APHA (1995)
Colour/Turbidity	Colorimetry	APHA (1995)
Conductivity/ Total dissolved solids (TDS)	Conductivity meter	APHA (1995)
Total suspended solids(TSS)	Gravimetry	APHA (1995)
Nitrate (NO_3^-)	Spectrometry	APHA (1995)

METHODOLOGY CONT.
Table1b cont.

PARAMETERS	METHOD / INSTRUMENT	REFERENCE
Sulphate (SO_4^{2-})	Turbidimetry	APHA (1995)
Chloride (Cl^-)	Titrimetry	APHA (1995)
Phosphate (PO_4^{3-})	(Vanado-molybdo Phosphoric Acid) Colorimetric	APHA (1995)
Chemical oxygen demand (COD)	Titrimetry (Wet-Oxidation)	APHA (1995)
Na, K, Mg, Ca, Cd, Cr, Cu, Fe, Mn, Pb and Zn	Atomic Absorption Spectrophotomery (AAS)	APHA (1995)

RESULTS

The results are presented in Tables 2 and 3

Table 2: Mean Values of Physico-chemical Parameters of Herbal Mixture Effluent

Parameters	October (Mean ±SD)	December (Mean ± SD)	NESREA
Water temperature °C	27.51±0.085	28.40±0.283	40.0
Apparent colour Pt.-Co.	1579.35±0.071	1643.32±0.821	Colourless
Turbidity (NTU)	140.84±0.057	144.11±0.157	5.0
Ph	6.11±0.165	6.21±0.127	6.0-9.0
Acidity ($mgCaCO_3$/L)	170.0±7.071	180.0±11.31	NA
Alkalinity($mgCaCO_3$/L)	200.0±2.828	220.0±7.543	NA
DO (mg/L)	4.132±0.009	4.088±0.011	3.0
BOD (mg/L)	20.05±1.655	24.40±0.566	20.0
COD (mg/L)	301.01±0.041	297.87±0.431	40.0
TSS (mg/L)	639.0±12.73	643.0±1.414	10.0
TDS (mg/L)	293.0±0.009	348.6±0.283	500.0
Conductivity (µS/cm)	488.0±11.31	498.0±13.01	1000.0
Sulphate (mg/L)	91.06±0.078	92.08±0.042	100.0
Nitrate (mg/L)	9.733±0.004	9.156±0.007	10.0
Chloride (mg/L)	23.18±0.014	23.35±0.071	100.0
Phosphate (mg/L)	6.793±0.004	6.571±0.071	2.0
Na (mg/L)	1.009±0.012	2.998±0.003	NA
K (mg/L)	3.991±0.001	3.189±0.001	NA
Ca (mg/L)	1.872±0.002	3.199±0.001	NA
Mg (mg/L)	3.711±0.002	2.019±0.001	NA
Cd (mg/L)	0.122±0.001	0.119±0.003	0.1
Cr (mg/L)	0.010±0.008	0.006±0.001	0.01
Cu (mg/L)	0.281±0.005	0.281±0.001	1.0
Fe (mg/L)	0.122±0.002	0.188±0.001	2.0
Mn (mg/L)	0.099±0.001	0.051±0.006	1.0
Pb (mg/L)	0.010±0.003	0.008±0.007	0.1
Zn (mg/L)	0.119±0.002	0.131±0.002	5.0

S.D = Standard Deviation, NA = Not Available, NESREA= National Environmental Standards and Regulations Enforcement Agency

Table 3: Physicochemical parameters of well water samples

Parameters	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	WHO	P value
Water temperature °C	23.50	25.63	23.38	26.25	25.35	26.25	25.13	40.0	0.108
Apparent colour Pt.-Co.	59.97	56.97	224.90	595.75	1280.3	435.82	219.91	Colourless	0.510
Turbidity (NTU)	7.72	5.99	10.17	59.17	104.93	22.42	11.71	5.0	0.944
pH	8.28	6.78	7.89	10.18	9.18	9.25	6.40	6.5-8.5	0.284
Acidity (mgCaCO$_3$/L)	25.50	44.25	35.00	41.88	66.75	67.5	69.65	-	0.011
Alkalinity(mgCaCO$_3$/L)	77.05	33.07	62.75	614.25	246.77	269.75	41.65	-	0.742
DO (mg/L)	3.98	3.33	4.40	1.50	1.30	0.30	3.49	3.0	0.033
BOD (mg/L)	43.49	43.17	49.28	50.00	49.65	53.02	52.13	50.0	0.003
COD (mg/L)	24.23	23.47	26.31	25.88	29.72	30.60	32.28	-	0.972
TSS (mg/L)	81.85	61.85	70.08	288.50	210.50	88.90	92.40	150	0.554
TDS (mg/L)	74.65	59.40	78.43	721.50	327.75	334.60	59.43	500.0	0.878
EC (µS/cm)	117.43	98.83	131.03	1204.5	544.75	556.75	100.64	1000.0	0.869
Sulphate (mg/L)	33.01	13.00	13.720	52.90	73.49	78.03	66.19	250.0	0.164
Nitrate (mg/L)	0.492	0.566	0.744	1.301	1.326	0.834	0.541	50.0	0.151
Chloride (mg/L)	85.79	31.70	79.14	270.20	190.30	217.83	131.74	250.0	0.051
Phosphate (mg/L)	3.966	4.220	4.210	4.281	5.509	6.791	5.069	5.0	0.203
Na (mg/L)	12.528	8.718	10.838	4.308	17.00	14.68	18.09	200.0	0.001
K (mg/L)	2.958	3.637	2.445	5.869	2.697	4.025	3.748	10.0	0.000
Ca (mg/L)	20.41	12.67	21.13	22.92	37.19	13.35	34.23	75.0	0.056
Mg (mg/L)	3.353	2.776	2.707	3.227	4.065	1.316	4.132	50.0	0.000
Cd (mg/L)	0.071	0.077	0.060	0.058	0.052	0.065	0.122	0.003	0.017
Cr (mg/L)	0.161	0.143	0.133	0.149	0.139	0.119	0.113	0.05	0.000
Cu (mg/L)	0.097	0.103	0.088	0.097	0.119	0.109	0.107	2.0	0.045
Fe (mg/L)	0.039	0.046	0.036	0.045	0.119	0.057	0.091	0.3	0.057
Mn (mg/L)	0.059	0.062	0.048	0.046	0.070	0.039	0.056	0.1	0.000
Pb (mg/L)	0.041	0.017	0.055	0.077	0.016	0.004	0.052	0.01	0.001
Zn (mg/L)	0.097	0.176	0.091	0.135	0.119	0.112	0.123	3.0	0.000

*P<0.05 significant.

W.H.O. =World Health Organization

DISCUSSION

- In Table 2, the mean values obtained for apparent colour, turbidity, total suspended solid, phosphate and chromium were above NESREA limit .

- Dissolved oxygen, biological oxygen demand, chemical oxygen demand were also higher than the permissible limits .

- High suspended solid, apparent colour and turbidity in the effluent could be associated with materials used in herbal mixture production. The presence of such waste material in the environment could lead to increased organic matter in receiving water bodies, hence inimical.

DISCUSSION

- The pH values of the effluent were slightly acidic.

- Sources of pollution from the industries could be associated with herbal materials used, herbal cooking pots, water source, tanks and waste storage. Also effluent discharged volume and concentration, cleaning process in the industries could be associated with pollution in the effluent.

DISCUSSION

- In table 3, The apparent colour and turbidity values of well water were higher in well 5 than other wells.

- TSS mean values obtained for the well 4 and well 5 are much higher than the recommended 150 mg/L limit of W.H.O; higher values of TSS can also lead to increased turbidity.

- The mean pH of well 4, well 5 and well 6 are more than permissible range (6.5 – 8.5) of W.H.O.

DISCUSSION

- The mean values of DO (3.0 mg/L, W.H.O., 2008) are exceeded in wells 1, 2, 3 and 7. The BOD_5 studied exceeded the safe limit for drinking water quality in wells 4, 6 and 7. Chemical oxygen demand mean concentrations were above the permissible limits-10 mg/L (W.H.O., 2008) in the entire wells.

- Phosphate concentrations exceeded safe limits (W.H.O) meant for domestic uses in wells 5, 6 and 7, while mean values of chloride also exceeded the permissible limit (250 mg/L) in well 4.

DISCUSSION

- The range of mean values obtained in the entire wells for Cd and Cr were above W.H.O. standard while Fe, Mn, Cu and Zn were below W.H.O. standard. The mean concentrations of Pb are higher than W.H.O standard limits in the entire wells except well 5 (Table 3).

CONCLUSION

- Continue discharge of untreated effluent from an Herbal mixture industries into the open drainage have resulted over the years into pollution of groundwater located around the effluent's drainage.

- This study concludes that there is need to treat the wastewater from Herbal mixture industries before being discharged. Also the method of discharge should be according to standards.

THANK YOU FOR LISTENING