A STUDY OF THE QUALITY OF EFFLUENT FROM FOUR FOOD PROCESSING INDUSTRIES IN NIGERIA: CASE STUDY OF LAGOS STATE.

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Abstract

This paper presents the result of a study on a quality of effluent from four food-processing industries in Lagos stale. The study involves the collection of samples at the point of discharge into the Lagos- lagoon. All the sample were tested, and the average result obtained were compared with that of FEPA standard and three out of four industries (Coca- Cola, Nigeria Brewery and Guinness Nigeria I'LC) did not satisfy the FLI'A standard while Pepsi-Cola factory satisfies the FLPA standard for effluent discharge into the surface water.

Introduction

Today, due to the ever-increasing demand for more and more water, plans for water reuse are spreading to many areas of the world not normally considered arid. Wastewater reuse technology has now become a major area of interest to engineers, biologists, chemists, agronomists, public health officers and water resources authorities. Their concern may vary from the need to prevent surface water pollution, the desire to conserve and recycle soil nutrients, and the developments of additional resources for agriculture, industry or urban uses, as well as the protection of public health and others (Metcalf and Eddy, 1991). It is clear that in the United States and many other parts of the world, recycling and reuse of all our resources will have to become a way oflife. The president of the United States stated the case well when presenting to the congress, the first report on environmental quality (1970). Me said, we could no longer afford the indiscriminate waste of our natural resources, neither should we accept as inevitable, the mounting costs of waste removal. We must move increasingly toward closed systems that recycle what are now considered wastes back into useful and productive purposes' (Shuval. 11.1, 1977). The sanitary engineer can design a treatment plant to accomplish as much removal of pollutants as may be required. Ultimate disposal of wastewater effluents will be by dilution in receiving waters, by discharge on land, or in some cases in desert areas, by evaporation into the atmosphere as well as seepage into the ground. Disposal by dilution (after secondary treatment) in large bodies of water, such as lakes, rivers, estuaries, or oceans is by far the most common method (Bittner Alfred and Neis Vwe, 1984).

The fundamental thesis governing the disposal of effluents and the regulation of pollution is to make the treatment plants do part of the work and to let nature complete it. In the past, however, the balance was often shifted and nature was called upon to do far more than its share of the work. Consequently, the assimilative capacity of the receiving waters and natural lands were exceeded and condition of pollution resulted (Arceival S, 1981). Waste materials are a necessary penalty man pays for industrialization. It is often said that water is essential for variety of human activities including consumption, sanitation, recreation, irrigation, the manufacture of industrial goods and the production of food and fibre.

The purpose of the paper is to ascertain the quality of the effluent discharged by some food processing industries to awaken FEPA and other related agencies to their own responsibility

Materials and Method

Wastewater samples were collected at the point of discharge into the Lagos- lagoon during the period of high production between August and March 2001 from the four food processing industries, the industries use up to 40,0001iters of water daily on the average and discharges a waste of about 5000 to 10,0001 iters daily. A total of 240 samples were collected from the four industries where it will give a good representative of the effluent. The entire sample were analysed within few hours of collection. A field survey of the industrial wastewater treatment plants available in the four industries was also carried out.

Results

Tabulation of values obtained for the respective four (4) (bod processing industries. Table A (NR I.)

S/N	PARAMETER	UNIT	EFFLUENT (NBL)	FEPA STANDARD	REDUCTION REQUIRED	COMMEN'I
1	PH		4.6	6-9	NIL	F.T.R.
2	Total solids	Mg/I	2530		-	-
3	Suspended Solid	Mg/I	840	30	810	F.T.R.
4	Settleable Solid	Mg/1	311	-	-	-
5	Dissolved Solid	Mg/I	2219	2,000	219	F.TR.
6	Alkalinity	Mg/1	-	-	-	-
7	Hardness	Mg/1	-	-	-	-
8	Conductivity	Mg/1	1340	-	-	-
9	Sodium	Mg/1	40	-	-	-
10	Potassium	Mg/1	28	-	-	-
11	Calcium	Mg/1	9.0	200	NIL	T.O.K
12	Magnesium	Mg/1	7.6	200	NIL	T.O.K
13	Chloride	Mg/1	-	600	NIL	T.O.K
14	Phosphate	Mg/1	-	5	NIL	T.O.K
15	BOD5	Mg/1	1,250	30	1220	F.T.R.
16	Cod	Mg/I	-	-	-	-
17	Zinc	Mg/1	1.7	< 1	0.8	F.TR.
18	Copper	Mg/1	0.2	< 1	NIL	T.O.K.
19	Manganese	Mg/I	0.5	5	NIL	T.O.K
20	Lead	Mg/1	”	< 1	NIL	T.O.K

KEY.

FEPA STANDARD = Limit for discharge into surface water.
T.O.K. = Treatment okay
F.TR. = Further treatment required
= No trace is noticeable.
= No comment

From the table above the PH is not within the range of FFPA standard of 6 9, therefore the effluent is slightly acidic. It is also shown that 91.5% of the suspended solid should be removed to meet up with FEPA standard. Dissolved solid and zinc requires a little further treatment to meet up the standard.

The BOD_5 AT 20°C is higher than FEPA standard by 1220mg/l which is 97.6% of the total BOIL in the influent discharged. All the other parameters are okay by FEPA standard.

Table B (Guinness)

S/N	PARAMETER	UNIT	EFFLUENT (GUINNESS)	FEPA STANDARD	REDUCTION REQUIRED	COMMENT
1	PH		8.6	6-9	NIL	T.OK.
2	Total solid	Mg/1	914	-	-	-
3	Suspended Solid	Mg/1	354	30	324	F.T.R
4	Settleable Solid	Mg/1	76	_	.	.
5	Dissolve Solid	Mg/1	560	2,000	NIL	T.O.K
6	Alkalinity	Mg/1	28.5	-		-
7	Hardness	Mg/1	78	-	-	-
8	Conductivity	Mg/1	960	-	-	-
9	Sodium	Mg/1	-	-	-	-
10	Potassium	Mg/1	-	-	-	-
11	Calcium	Mg/1	-	200	NIL	T.O.K.
12	Magnesium	Mg/1	-	200	NIL	T.O.K.
13	Chloride	Mg/1	-	600	NIL	T.O.K.
14	Phosphate	Mg/1	-	5	NIL	T.O.K
15	BOD5at20C	Mg/1	1,250	30	1220	F.T.R
16	Cod	Mg/1	780	-	-	-
17	Zinc	Mg/1	-	< 1	NIL	T.O.K
18	Copper	Mg/1	-	< 1	NIL	T.OK
19	Manganese	Mg/1	-	5	NIL	T.O.K
20	Lead	Mg/1	”	< 1	NIL	T.O.K

All other parameters are okay according to FEPA standard with the exception of suspended solid and BODs at 20°C in the table above, the suspended solid has an excess of 324mg/l which is 91.53% of the total suspended solid in the influent.

The BOD_5 at 20°C is higher than FEPA standard by 1220mg/l, therefore, further treatment is required to meet up with the standard of 30mg/l.

Table C (Pepsi-cola)

S/N	PARAMETER	UNIT	EFFLUENT (PEPSICO! A)	FEPA STANDARD	REDUCTION REQUIRED	COMMENT
1	PH		9.0	6-9	NIL	T.O.K
2	Total soils	Mg/1	770	-	-	-
3	Suspended Soil	Mg/1	10	30	NIL	T.O.K
4	Settleable Soil	Mg/1	6			
5	Dissolved Soil	Mg/1	760	2,000	NIL	T.O.K
6	Alkalinity	Mg/1	322.5	-	-	-
7	Hardness	Mg/1	105	-	-	-
8	Conductivity	Mg/1	990	-	-	-
9	Sodium	Mg/1	124	-	-	-
10	Potassium	Mg/1	22	-	-	-
11	Calcium	Mg/1	39	200	NIL	T.O.K
12	Magnesium	Mg/1	1.3	200	NIL	T.O.K
13	Chloride	Mg/1	11	600	NIL	T.O.K
14	Phosphate	Mg/1	1.0	5	NIL	T.O.K
15	BOD5 at20c	Mg/1	-	30	NIL	T.O.K
16	COD	Mg/1	-	-	-	-
17	Zinc	Mg/1	0.4	<1	NIL	T.O.K
18	Copper	Mg/1	0.10	<1	NIL	T.O.K
19	Manganese	Mg/1	-	5	NIL	T.O.K
20	Lead	Mg/1	0.05	<1	NIL	T.O.K

mom the table above all the content of the parameters in the effluent are okay (further treatment not required) based on FEPA standard.

Table D (Coea-cola)

S/L	PARAMETER	UNIT	EFFLUENT (COCA-COLA	FEPA STANDARD	REDUCTION REQUIRED	COMMENT
1	Pll		1 1-1	6-9	NIL	EVER
2	Total soil	Mg/1	3,000	-	-	-
3	Suspended Soil	Mg/1	20	30	NIL	T.O.K
4	Settleable Soil	Mg/1	14	-	-	-
5	Dissolved Soil	Mg/1	2980	2,000	980	F.T.R
6	Alkalinity	Mg/1	350	-	-	-
7	Hardness	Mg/I	308	-	-	-
8	Conductivity	Mg/1	1850	-	-	-
9	Sodium	Mg/1/1	170	-	-	-
10	Potassium	Mg/1	9	-	-	-
11	Calcium	Mg/1	94.8	200	NIL	T.O.K
12	Magnesium	Mg/1	7.6	200	NIL	T.O.K
13	Chloride	Mg/1	47	600	NIL	T.O.K
14	Phosphate	Mg/1	10.5	5	5.5	F.T.R.
15	BOD5	Mg/I	-	30	NIL	T.O.K
16	Cod	Mg/I	-	-	-	-
17	Zinc	Mg/I	0.1 1	< 1	NIL	T.O.K
18	Copper	Mg/I	0.05	< 1	NIL	T.O.K
19	Manganese	Mg/I	-	5	NIL	T.O.K
20	Lead		0.05	< 1	NIL	T.O.K

The PH requires further treatment so that it will fall within the range of FEPA standard of 6 - 9. Dissolved solid value is also found to be higher than FEPA standard of 2000mg/l by 980mg/l, therefore further treatment is required.

Phosphate also requires further treatment since the effluent content is higher than FEPA standard value by 52.4% of the total content of 10.5mg/l.

Discussion of Results;

The quality of effluent generated by the respective four (4) food processing industries can be subject to wastewater reuse technology, in order to obtain optimal beneficial purposes in the areas of agricultural reuse, municipal reuse, industrial reuse, groundwater recharge reuse and recreational reuse.

The average BOD_5 at 20°C for two of the industries, NBL and Guinness, was found to be higher than FEPA standard value of 30mg/l by 1220mg/l, which is 97.6% of the effluent BOD_5 at 20°C. Their suspended solid is also higher than FEPA standard (30mg/l) by 324mg/l and 81()mg/l; these values are 91.5% and 96.4% of the content present in the effluents for NBL and Guinness respectively.

The dissolve solid for Guinness and Pepsi Cola are below FEPA standard value, while NBL and Coca-Cola are having 219mg/l and 980mg/l (10% and 33%) on the average above the FEPA standard of 2000mg/l, with the Coca-Cola having the highest remaining dissolved solid of 33% to be removed. The NBL PH is found to be 4.6, which is not within the range of FEPA standard of 6-9, while coca-cola has a PH of 1 1 . 1 . The zinc content of NBL effluent is tested to be 1.7mg/l which is greater than the FEPA standard value of less than lmg/1 by approximately 0.8mg/l, therefore, 47.1% of the zinc content should be reduced to meet up with FEPA standard.

Phosphate content in Coca-Cola effluent is also tested to be 10.5mg/l, which is 5.5nig/l higher than the FEPA standard of 5mg/l; therefore, the effluent phosphate should be reduced by 52.4% in order to meet up with the FEPA standard for discharge of effluent into surface water. All other tested parameters are found to be in compliance with FEPA standard. Stabilization found with pretreatment unit is recommended for NBL and Guinness for the reduction of BOD* at 20°C, to enhance the

efficiency of their available wastewater treatment facilities, which are not meeting up with the standard because of low installation capacity and may be poor maintenance culture.

From observation, it is clear that, the inclusion of anaerobic pretreatmcnl helped the saving of 67% in pond area and 59% in retention time. With the designed pond area, A, and Pond retention time, t*, recommended for use, for the respective ponds, the influent BOD_5 of both NBL and Guinness, respectively, will be reduced to the minimum, such that, it conforms with the standard requirements set by FEPA, before final discharge into the Lagos-Lagoon.

Recommendations

From the investigation and analyses carried out in this research work, the following recommendations based on the quality of effluent from four food-processing industries in Lagos-state, are made:

(1) The industrialists in Nigeria must 'wakc-up from their slumber' and practise the wastewater reuse technology, so that, optimal beneficial purposes can be derived from its application, instead, of the routine wastage of limited natural resources.

(2) Wastewater to be used for various beneficial purposes must conform to W.H.O. Standard treatment processes.

(3) Local authorities should be set up in Nigeria, as approved by W.ll.O. and empowered by federal and stale governments, to monitor and control the quality of effluents to be used for the various beneficial purposes.

(4) The industrialists must satisfy both W.ll.O. and FEPA standard requirements for effluent discharge into the Lagos-Lagoon

(5) Any industrial factory that constantly fails to comply with the set rules and regulations of both W.H.O. and F.E.P.A., on a day-to-day activities should be outrightly sealed up until they put a satisfactory arrangement for the proper and safe disposal of their industrial effluents.

(6) The state government should build industrial wastewater treatment plants around Lagos state, where companies can discharge their effluent and pay for its treatment under the management of the state's ministry of environment and planning and FLPA'S Lagos office.

(7) Any industry that cannot afford on-site treatment plants should send their uniform wastewaters to the central sewage treatment system (known as the communal treatment plant) and be ready to pay certain effluent charges according to (he volume of their wastewater that is sent across.

(8) Recognizing the limitation of the stabilization pond in the removal or reduction of concentration of suspended solids present in the effluent, 1 hereby, recommend solids separation methods, such as; conventional and large earthen settling basin in scries, Chemical precipitation, fine screening, intermittent sand and rock filters in the removal or reduction of the concentration of suspended solids that are present in the stabilization pond effluent.

(9) Environmental Impact Assessment (E1A) should be carried out before siting an industry at any place.

(10) Environmental Impact (El) auditing should be carried out on regular basis to know the condition of the environment with time.

Lastly, this research work, 'echoed' the need for adequate protection strategies required in the field of wastewater reuse technology and disposal of industrial effluent cither on land or in surface- water, this is necessary, in-order to prevent health related hazard on the public, land, fresh- groundwater, surface water (Lagos-Lagoon), aquatic lives and plants, etc.

Conclusions

The quality of effluent from food processing industries in Lagos stale, is such that, it can be subjected to wastewater reuse technology, in-order to obtain optimal beneficial purposes in the areas of agriculture reuse, municipal reuse, industrial reuse, recreational reuse, and ground water recharge reuse. The major problem is that the available treatment plants are not well maintained to serve its purpose or the installed plants are too small to cater for the generated effluent.

The industrial effluents from four (4) food processing industries, in Lagos state, will be harmful, if not secondary treated before disposal, but when treated, it will be safe when disposed on land, fresh groundwater, surface water, etc. From the analyses carried out on the data obtained from four (4) food processing industries based in Lagos stale, it was observed that NBL, GUINNESS

NIGERIA PLC, COCA-COLA FACTORY did not fully satisfy FEPA standard requirements for effluent discharge into the surface water, hence, further treatment is necessary, to avoid pollution of the Lagos-Lagoon. Only PEPS1-COLA FACTORY satisfied FEPA standard requirements for effluent discharge into the surface-water.

Finally, serious actions are required now to save the populace from effluents from companies, due to lack of proper and safe industrial waste treatment plants.

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