EVALUATION OF PHYSICAL AND CHEMICAL PARAMETERS OF EFFLUENTS IN OPEN DRAINS IN YOLA, ADAMAWA STATE, NIGERIA

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Abstract
The aim of this study is to evaluate the physical and chemical properties of discharged effluents in Yola. The physical and chemical parameters analysed in-situ for effluents in open drains in the study area, using field equipment were, colour, biochemical oxygen demand, electrical conductivity, total dissolved solids, phosphorus, total hardness, pH, dissolved oxygen, and temperature. Unacceptable high levels of the parameters were observed in the effluents monitored during the study, thereby failing to comply with the World Health Organisation's (WHO) tolerance limits. Basically, effluents of the drainage channels in Yola are highly polluted. This calls for their treatment and recycling. Therefore, relevant authorities should endeavour to control, regulate, and educate the populace on indiscriminate effluents disposal within the study area.

Key Words: physical and chemical parameter, effluents, drainage channels, open drains.

Introduction

The increasing rate of urbanization and population growth and natural increase and rapid influx of in-migration from villages and small towns in developing nations has given impetus to unprecedented generation of effluents at an alarming rate. In cities, large amount of untreated effluents occasioned by human activities basically increases physical and chemical contents of effluents with adverse implications on human health, aquatic life, and ecological balance in several ways.

Increasing concentration of chemical substances in wastewater and effluents is of great concern, owing to the fact that, various organisms need varied degrees of such substances for their survival. As in Akan, *et al* (2008), both deficiency and excess of micro nutrients, such as the biochemical oxygen demand, nitrate, pH, electrical conductivity, could give rise to undesirable effects. For instance, high values of pH in a river have been reported to affect aquatic life and toxicity of other pollutants in one form, or the other. High values in a river for, instance, impair recreational uses of water and affect aquatic life. On the other hand, a decrease in pH values could also reduce the solubility of certain essential element, such as the selenium, while at the same time, low pH raises the solubility of several other elements such as iron (FE) etc. Effluent discharge is one of the concerns currently confronting the study area with, or without appreciable effort being made by relevant stakeholders to control it. Water polluted by effluents from various sources, is linked with disease burden and this is likely to influence the present shorter life expectancy in developing nations as against the developed nations (Ibrahim, 2007).

The objective of this study is to evaluate the physical and chemical properties of discharged effluents in Yola. The parameters determined include colour, biochemical oxygen demand, electrical conductivity, total dissolved solids, phosphorus, total hardness, p^H, dissolved oxygen demand, and temperature. These physical and chemical characteristics of the effluents can have adverse effects on the environment, and human public health, in particular.

The Study Area

Yola is a twin city, consisting of Jimeta and Yola town that form the capital of Adamawa State. It is located on latitude 9º 120' N and longitude 12º29' E (RAHALT Consulting Engineering Nigeria Ltd, 1995) as in Fig.1. According to Omar (2000), Jimeta and Yola, jointly occupy a total land area of 1,213 km^2. Yola has a tropical and dry climate (Aw), having the mean day length varying from 11.5 to 12.5 hours, and slightly longer in the wet reason.

Material and Methods

Effluents sampling was done from the open drains in six wards, selected by stratified random sampling technique, from the existing twenty wards, in the study area. They were selected in such a way that, two wards were chosen by systematic random sampling, from each of the high medium, and high, density residential areas.

In each of the selected wards, eight samples of the effluents were measured at the disposal and discharge points (Fig. 2). These were made up of two samples from each of the four selected sampling sites, thereby giving rise to forty-eight (48) samples of effluents collected in the study area.

The temperature, pH value, colour, electrical conductivity, and the total dissolved solids of the samples were determined on the field, using a Hanna IH991300 portable PH/EC/TDS/.Temperature Meter for pH, electrical Conductivity, total dissolved solids, and temperature.

On the other hand, dissolved oxygen concentration was measured in the field, using another Hanna IH9142 portable waterproof dissolved oxygen meter equipment. Distilled water was used to cleanse the equipment after each sampling, to eliminate impurity and interference. As for the values of biochemical oxygen demand, phosphorus, total hardness, and colour, Hanna C213, was used to determine the parameters in-situ. The analytical procedures employed in the study include both the descriptive statistics, such as the means, percentages, and the inferential statistics of the students' t-test to investigate the significance of the differences in the concentrations of the affected parameters in the effluents between the wards.

Results and Discussion

Colour

Of important note is colour that the appearance and colour of most of the samples is dark, measuring 86HZ (Hazen Units) at Runde ward. It is significant to note that the catchments with dark effluents which could be related to discharge of excreta from bucket latrines and pit latrines, are densely populated, while catchments with a clearer appearance are sparsely populated. The results in the Table 1 indicate that high and medium density residential areas revealed high values for electrical conductivity (implying high salt contents of effluent samples), total dissolved solids, total hardness, and colour.

pH Value

Also depicted in the Table 1, are the pH Value levels of 9.9, 10. 5, and 10.8, for Demsawo, Runde, and Luggere wards, respectively. These levels are outside the World Health Organization's (WHO's) permissible value range of 6-9 and signifies the presence of contamination, particularly from mineral acids and alkalines (Ademorati, 1996). The outcomes indicate that effluent samples from all the catchments registered strong alkaline reactions with the exception of Makama, and Jambutu wards, only.

Dissolved Oxygen Demand (DOD)

In the same way, low quantities (amounts) of dissolved oxygen (DO) in the effluent samples, ranging from the value 4.04 in Makama ward, to- 2.15 mg/L in Runde ward, particularly in the effluents from the drains in Runde ward, show an excessive load of organic waste. These are capable of having adverse effects on fish and other

aquatic life. Such levels are related to low pH values, according to Ogugbuala and Madu (1993).

Total Dissolved Solids (TDS)

The mean total dissolved solids (1016mg/L to 1288mg/L) and electrical conductivity concentration levels (2,0395 scm^1 to 1569scm^1) are excessive for irrigation as in Essiet and Ajayi (2002).

Temperature, Total Hardness, Phosphorus, Electrical Conductivity

However, a considerable relationship can be observed between the high temperature and high concentrations of these variables in the effluent samples analysed using student *t-test*. This is on grounds that, chemical activity is generally increased by high temperatures. As for the dissolved oxygen levels, high temperatures, instead, reduce its levels. In a nutshell, the results in Table 1 indicate that, high density residential areas revealed high concentrations, or values for biochemical oxygen demand, total dissolved solids, total hardness, electrical conductivity, pH, phosphorus, and temperature, but low values for dissolved oxygen. This suggests oxygen depletion arising from the mixture of the effluents with the rivers which can be harmful to aquatic life. Also, the reported cases of water diseases affecting some people in the study area as in CEM, and Ibrahim, (2002; 2007), could be linked to high concentration of the elements in the effluents.

Table 1: Physical and Chemical Parameters of Effluents in Open Drains in Yola

Wards / Parameters	Luggere (High Density)	Runde (High Density)	Demsawo (Medium Density)	Makama (Medium Density)	Karewa (Low Density)	Jambutu (Low Density)	WHO Standard Value
Appearance	Dark	Dark	Dark	Clear	Clear	Dark	
Colour (HZ)	78	86	73	66	70	71	50
Biochemical Oxygen Demand (mg/L)	65	61	53	4.2	2.2	7.3	200
Electrical Conductivity (scm^1)	2,039	1,502.13	1,569.88	456.8	2,039	949	-
Total Dissolved Solids (mg/L	179	1016	754.7	2050.7	1,288	476.8	500
Phosphorus mg/L	53	22	34	28.3	2.35	26.7	-
Total Hardness ($mg/Lcaco_3$)	57	75	59	43	36	68	500
pH	10.8	10.5	9.9	8.00	7.75	5.9	6-9
Dissolved Oxygen (ppm)	1.79	2.15	1.5	4.04	1.4	3.98	-
Temperature at ^oC Collection of samples	23.3	21.5	20.0	32.9	28.4	26.0	none

Source: Field Survey, February, 2011

Conclusion

From the data collected for this study, the physical and chemical parameters measured from the effluents of the open drains reflected high levels of concentration in the high density residential areas. Similarly, parameters monitored from the effluents in the medium density residential areas, showed medium concentration levels, with those monitored in effluents in the low population density residential areas, being correspondingly, low. In conclusion, concentrations of the physical and chemical parameters in all the effluents in the drains in Yola were higher than the values set by the World Health Organization (WHO). Treatment and recycling of the effluents are therefore desirable. In view of this, there is need for relevant authorities to control, regulate and educate the populace on how to properly manage effluents in the study area.

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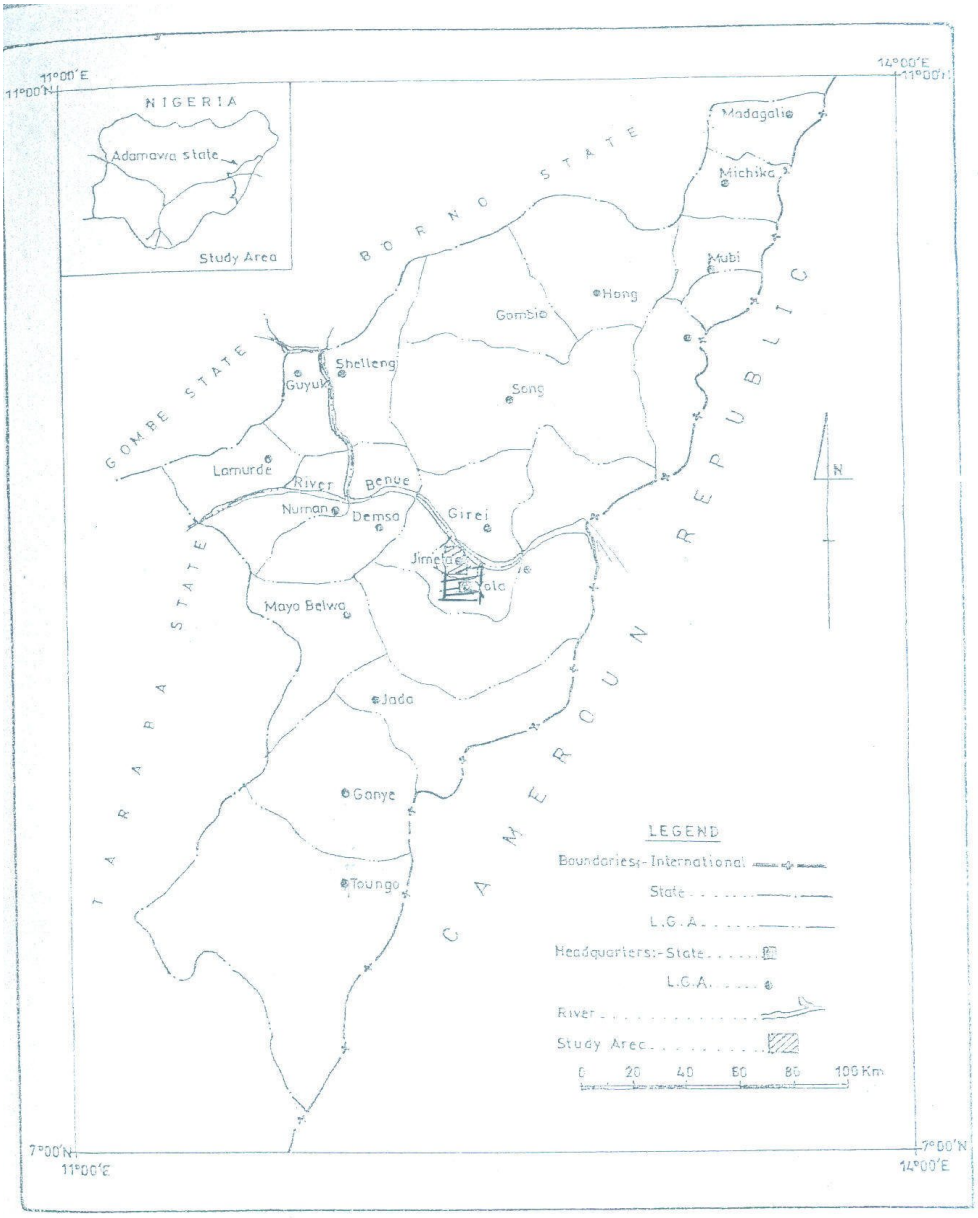

FIG. 1 ADAMAWA SHOWING STUDY AREA