

Characteristics and Control of Effluents Generated From Industries in Port Harcourt, Nigeria.

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ABSTRACT: A study was conducted to determine the characteristics of effluents and possibly suggest measures of control of those organic pollutants and pathogenic agents present in those Industrial effluents generated in Port Harcourt, Nigeria using physico-chemical and bacteriological parameters such as Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solid (SS), Total Organic Carbon (TOC), Colour, Hydrogen-ion Concentration (pH), Iron, Nitrate, Turbidity, Temperature and E.Coli. The raw wastewater generated in 5 industries namely Photographic Processing Industry, Hair Dressing Salon, Laundry, Food Processing and Cement Industry was examined. The pH, BOD, COD, SS, turbidity, temperature and colour values exceeded the stipulated standard by WHO. While, TOC, DO, iron, nitrate and E.coli are within the acceptable range. Treatment of those industrial effluents is necessary to save groundwater, streams and rivers within the areas where the industries are located.

KEYWORDS: Effluents Characteristics, Control, Industries, Port Harcourt, Nigeria.

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I. INTRODUCTION

Effluents generated from industries to the environment (water or land) are inevitable as they are associated with the rapid industrialization. They are one of the major sources of pollution and constitutes public health hazard. Batch electrocoagulation studies were performed to evaluate the influence of various experimental parameters such as applied voltage and electrolysis time on the removal of pollutants from dairy wastewater [1]. Effluent Treatment Plant located in Kagal was used for the treatment of effluent discharged by High Rate Transportation System [2]. The effluents came in diverse form but basically in there (3) categories namely: liquid, solid and gaseous forms with a wide range of chemical and pathogenic contents which are contaminants, constituting public health hazard. Consequent to the implementation of policies and enactment of laws from the regulatory bodies, were there noticeable benefits in the re-use of effluents, tagged "from waste to wealth". The Rivers State Ministry of Environment in Port Harcourt Rivers State encouraged and advised a re-cycling method wherever it is possible, thereby conserving water.

According to Kesalkar et al, [3] the physico-chemical characteristics of wastewater from paper industry were characterized by variety of colour, extreme quantity of chemical oxygen demand (COD), biochemical oxygen demand (BOD), concentration of hydrogen-ion (pH), total dissolve solids (TDS), low dissolved oxygen (DO) and high suspended solids (SS) which were carriers of these aforementioned constituents. Over the years, wastes have been unavoidable fact that accompanies life. Generation of wastes has been correlated to output of goods and services following the industrialization trend of the country [4]. Therefore, in a bid to check and balance, various countries placed various methods of regulation and standards aimed at providing their teaming populace with safety. The constituents were diagnosed potential pollutants which in its liquid form can percolate and contaminate underground water. They can also travel a reasonable distance horizontally through soil capillaries, get absorbed into the root nodules of plants, and get them infested. The public eating the plants also get directly infested. Animals eating the plants also get infested after which the public eating the animals get infested indirectly. Besides human's infestation, checks and balances on indiscriminate discharge of industrial effluents are inevitable in order to minimize environmental degradation and also to keep upright the water quality for public interest and safety in consuming water with confidence.

Effluent from milk processing unit contains soluble organics, suspended solids, trace organics which releases gases, causes taste and odour, impart colour and turbidity, and promote eutrophication. Which affect

and disturb the environment in this regard's aimed to study the physicochemical characteristics of wastewater generated from dairy industry with suitable treatment [5]. The advent of surplus small-scale industries is in high proportion than other sectors of the economy. It is also important to know that the indispensable material they use for their daily activities is water, therefore their used water need to be controlled effectively to minimize or possibly eliminate contact between human beings and wastes. Industries themselves are not dangerous to the environment or the nation but their polluting effects on the Nigerian environment (water bodies) make their presence dangerous to public health[6]. The study on Port Harcourt Refinery showed that effluent contained relatively high levels of Cadmium, Chromium and Zinc. *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Rhizopus stolonifer*, *Aspergillus niger* and *Chlorella vulgaris* have showed great ability to bioremove these metals from the effluent. However, the study demonstrated that physicochemical parameters such as pH, Organic carbon, Nitrate and Phosphate have direct relationship with the ability of these microbes to recover these heavy metals. The bioremoval process is by both bioadsorption and biosorption [7]. The extraction and purification processes of Palm oil generate different kinds of waste generally known as palm oil mill effluent and the environmental impact cannot be over emphasized; hence the need for treatment measures to reduce these impacts before discharge [8].

The study of Sangodoyin [9] on some high and low density areas of Ibadan came up with physico-chemical and bacteriological values of sewage samples collected from open drains serving several households in those areas having wastewater that was quite polluted with the high density area indicating higher values of BOD, alkalinity and hardness.

Dairy industry is among the most polluting of the food industries in regard to its large water consumption [10].

A study was carried out to examine some physico-chemical parameters in Warri refinery effluent and its effect on the receiving Iffie River [11]. The textile industry uses high volume of water throughout its operation, from the washing of fibers to bleaching, mercerizing, dyeing, printing and washing of finished products having a process data collection that was performed and integrated with a characterization of the process effluents in terms of treatability and reusability which was therefore concluded that textile effluents were highly polluted [12], [13]. Due to geometrical progression of population increase, according to Malthusian theory of population in economics, area of occupancy becomes a problem to the teeming populace. The low income earners, the peasant farmers and rural dwellers in Nigeria have resorted to reclaiming land with wastes without minding, or being in ignorance of the dangers and inconveniences pose by wastes in the bid to reclaim land (land fill) for occupancy [14]. This practice without doubt posed a threat to the nation's environment.

The characteristics of palm oil mill effluent depend on the quality of raw material and palm production processes in palm oil mill. The wastewater composition depends mainly on the season, raw matter quantity and the particular operations being conducted at any given time. Specifically, palm oil mill effluent (POME) is a general phrase referring to the effluent from the final stages of palm oil production in the mill. It includes various liquids, dirties, residual oil and suspended solids. POME in its untreated form is a very high strength waste, depending on the operation of the process, that is; informal, semi-formal and formal processes, the biological oxygen demand (BOD) of these wastes ranges from 25000 to 35000 mg/L. It contains about 94% water. POME actually is the sum controlling total of liquid waste which cannot be easily or immediately reprocessed for extraction of useful products and is run down the mill internal drain system to the so called effluent (or sludge) pit [8]. This study is aimed at examining the techniques of wastewater disposal to environment by different industries and to check if those techniques are appropriate and also meet up with the World Health Organization (WHO) standard which was adopted by the Nigerian Federal Environmental Protection Agency (FEPA).

II. MATERIALS AND METHODS

Port Harcourt City is situated in the east of Rivers State, while Rivers State is a coastal city located in the Niger Delta region of Nigeria. It covers an area of about 2600 km² with a population of 1,382 592 according to the 2006 Nigerian census. The annual mean temperature ranges from 22°C to 32°C. The alternate effects of the tropical maritime and continental air mass produce two distinct seasons namely, wet and dry. The hot and humid tropical climate promotes bio-degradation of wastes.

The methods adopted for the research work are: sampling and analysis.

In search for information and data with which wastewater parameters would be examined, five (5) industries were considered which include: photographic processing industry, hair dressing salon, laundry, food processing industry and cement industry.

The under listed parameters were considered for examination using standard methods: Concentration of hydrogen-ion (pH), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solid (SS), Turbidity, Iron (Fe), Nitrate (NO₃), Dissolved Oxygen (DO), Temperature, Colour, Total Organic Carbon (TOC) and *E. coli*.

III. RESULTS AND DISCUSSION

The results obtained from the analysis for the wastewater samples collected from 5 industries namely: photographic processing industry, hair dressing salon, laundry, food processing industry and cement industry are duly presented in tables 1- 5.

Table1: Results of Wastewater Sample from Photographic Processing Industry

S/NO	Parameter	Results
1	pH	5.30
2	BOD	11.70
3	COD	51.08
4	SS	9.54
5	Turbidity(NTU)	13.55
6	Iron	1.33
7	Nitrate	5.26
8	DO	15.50
9	Temperature(°C)	32
10	Colour(Hazen)	13.78
11	TOC	5.51
12	E.Coli(MPN/100)	Nil

All parameters in mg/l except where stated.

The tabulated results of table 1 above indicate that BOD, COD, Turbidity, DO, Temperature, colour and TOC results had exceeded WHO standard while SS, iron and nitrate fall within the range of WHO standard and while pH value shows that wastewater is acidic.

Table II: Results of Hair Dressing Salon Wastewater

S/NO	Parameters	Results
1	pH	6.13
2	BOD	10.93
3	COD	48.87
4	SS	14.86
5	Turbidity(NTU)	12.38
6	Iron	0.95
7	Nitrate	3.49
8	DO	15.14
9	Temperature(°C)	29
10	Colour(Hazen)	9.41
11	TOC	3.02
12	E.Coli(MPN/100ml)	Nil

All parameters in mg/l except where stated.

Table II shows the results of analysed parameters in comparison with WHO standard that BOD, COD, turbidity, colour and DO were found to have exceeded the set standard. While the pH value, SS, iron, nitrate, temperature and TOC were found to be within WHO stipulated standard which means that if they are the only constituents available in that wastewater, there will be minimal pollution if discharged into the environment. The E.coli was exactly on the standard of WHO therefore, it would not be bordered about in disposing of wastewater from hair dressing salons.

Table III: Results of Laundry Wastewater

S/NO	Parameters	Results
1	pH	12.21
2	BOD	15.18
3	COD	43.44
4	SS	16.37
5	Turbidity(NTU)	16.40
6	Iron	1.74
7	Nitrate	4.08
8	DO	17.80
9	Temperature(°C)	32
10	Colour(Hazen)	-
11	TOC	5.28
12	E.Coli(MPN/100ml)	Nil

All parameters in mg/l except where stated.

From table III results, it was discovered that the pH value was high indicating that the wastewater of laundry is highly alkaline, BOD, COD, DO, SS, TOC and turbidity of laundry wastewater can pose serious problem if discharged indiscriminately to the environment without treatment as their values had exceeded WHO standard values, while iron, nitrate, colour and E.coli were found to be within WHO standard range.

Table IV:Results of Food Processing Wastewater

S/NO	Parameters	Results
1	pH	8.70
2	BOD	7.40
3	COD	11
4	SS	21.80
5	Turbidity(NTU)	15.06
6	Iron	0.60
7	Nitrate	0.70
8	DO	10.08
9	Temperature(°C)	31
10	Colour(Hazen)	12.66
11	TOC	1.96
12	E.Coli(MPN/100ml)	Nil

All parameters in mg/l except where stated.

In table IV, there is an indication that the following parameters can be properly considered for treatment before discharge of wastewater from food processing industry to minimize public health hazards in the environment; as the laboratory analysis results were found in the ranges of parameters exceeded WHO standard; are SS, DO, colour, temperature and turbidity while BOD, COD, TOC, pH and E.coli were within the acceptable range of WHO standard.

Table V:Results of Cement Industry Wastewater Sample

S/NO	Parameters	Results
1	pH	12.14
2	BOD	12.06
3	COD	40.60
4	SS	17.31
5	Turbidity(NTU)	13.89
6	Iron	1.28
7	Nitrate	0.91
8	DO	8.34
9	Temperature(°C)	32
10	Colour(Hazen)	9.30
11	TOC	3.80
12	E.Coli(MPN/100ml)	Nil

All parameters in mg/l except where stated.

It is evident from table V above that more than 50% of the analysed parameters were found to have exceeded WHO approved standard for wastewater. The pH, BOD, COD, SS, turbidity, temperature and colour values were actually exceeded WHO approved standard values. While, TOC, DO, iron, nitrate and E.coli are within the acceptable range.

From the results obtained, it was discovered that the pH values of photographic processing wastewater, hair dressing salon, laundry, food processing industry and cement industry are 5.30, 6.13, 12.21, 8.70, 12.14 respectively, indicating the laundry wastewater to have had the highest pH value followed by cement industry while the pH values of photographic processing industry wastewater, hair dressing salon and food processing industry were found to have falling within the acceptable range of pH value stipulated by WHO standard. It is therefore obvious that wastewater from laundry and cement industry are highly alkaline.

It will be interesting to know that cement industry and laundry ranked highest among the five (5) selected industries (photographic processing industry, hair dressing salon, laundry, food processing industry and cement industry) in polluting the environment, deriving from the data of laboratory analysis results, they are "silent time bombs" to the environment.

The other industries wastewater contained reasonable degree of contaminants also; the food processing industry, the photographic processing industry and the hair dressing salon.

IV. CONCLUSION

The results and observations of this study glaringly show that the organic strength of most industrial effluents is of a high degree that is enough to cause harm to the environment; both land and rivers. Wastewater sample from laundry as well as cement industry constitute the highest concentration of polluting constituents. Almost 70% of all the parameters analysed in the laboratory proved this to be true of effluents generated from laundry and 60% of cement industry respectively especially their pH values, BOD, COD, SS, Turbidity, DO, Temperature, TOC and Colour.

This study shows that wastewater treatment before disposal, should be taking as serious as possible. General findings during field survey showed us that many of the industries were not taking treatment of wastewater as a serious issue in Port Harcourt metropolis.

Since industries cannot be isolated from national development, there is no way we can state here that industry should be stopped for operations. It is obvious from the discussion that enough attention has not been paid to the environmental sector, which is the basis of good environmental quality in Port Harcourt city Local Government Area of Rivers State, Nigeria. Dissemination of environmental health related information to create awareness about the dangers involve in environmental degradation, if not taking proper care of and enforcement of all the environmental management policies.

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