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PHYSICOCHEMICAL CHARACTERIZATION OF DOMESTIC WASTEWATER BRUTES OF THE CITY OF CONAKRY FOR A TEST ADEQUATE TREATMENT

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ABSTRACT

The management of domestic wastewater poses many environmental problems that are becoming a concern for the health of the populations of the city of Conakry. The main objective of this study, which took place during the months of June, July and September 2021, is to determine the main physicochemical parameters of these effluents in order to recommend adequate treatment, thus reducing the nuisances suffered by the receiving environment and also remedy the loss of this water source in recoverable materials. The analyzes were carried out on twenty-five (25) samples of domestic wastewater, i.e. five (5) samples per commune of Conakry. The different parameters studied are: temperature, pH, electrical conductivity (EC), dissolved oxygen (O_2), turbidity (NTU), Suspended Solids (MeS), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD_5), Total Nitrogen (Ntot), Nitrite (NO_2^-), Nitrate (NO_3^-), Ammonium (NH_4^+) and Phosphate (PO_4^{3-}) ions. The results show that the average temperature values of the samples are between 26.80 and 30.20°C, with an average of 28.30°C. The pH values are close to neutral, they are between 6.7 and 8. The average EC values are between 750μs/cm and 1750μs/cm, with an average of 1238μs/cm. The average NTU value of the samples is 423.98 NTU. The average SS concentration is 310mg/L. The mean values of BOD5 and COD are respectively 138.19

mgO2/L and 156.59 mgO2/L. The average (Not) content of the samples is 92.52mg/L, those of Nitrates, Nitrite and Phosphate are respectively 2.16mg/L; 0.04mg/L and 0.26mg/L. The results of this research have made it possible to highlight the main physicochemical parameters of raw domestic wastewater from the city of Conakry. These results will make it possible to carry out an adequate treatment trial for these effluents for their recovery.

KEYWORDS: parameters, physico-chemical, wastewater, domestic, Conakry.

1. INTRODUCTION

At present, among the most worrying environmental problems, the problem of sanitation figures prominently. Indeed, human activity leads to the production of wastewater discharged into nature. This discharge into natural environments is a common practice in most developing countries. This situation is accentuated in urban centers because of the galloping demography that characterizes them. This is the case of Conakry, with a wastewater discharge of more than 10000000 m^3 per year, of which 783952 m^3 comes from the food and beverage industries.[1]

Water is a precious commodity that is subject to pollution and degradation from various sources (industrial, domestic, agricultural, etc.). It is necessary for all forms of life, it is a cardinal resource for the life and development of man on earth. This is why water is today at the center of the concerns of public authorities for its sustainable management. As an element of promoting hygiene, the health of individuals and the socio-economic development of human communities, it is fundamental for life but can also be a vector of disease.[2]

The physico-chemical properties of water are one of the main conditions that allowed the birth of life billions of years ago, but due to its irrational use by man, it suffers serious attacks with the degradation of its qualities, thus beginning its role of guarantor of life.[3] Discharges of these effluents into the natural environment in the absence of prior treatment constitute a growing danger to human health and the natural environment because of their loads of toxic chemical materials and pathogenic micro-organisms.[4,5,6]

Thus, the present study proposes to evaluate certain physico-chemical parameters such as (pH, conductivity, Nitrite, Nitrate, Phosphate, dissolved Oxygen, Iron, Zinc, Biological Oxygen Demand) of raw domestic wastewater from Conakry with a view to propose an adequate pre-treatment technique.

2. MATERIALS AND METHODS

2.1 Hardware

The present study is a continuation of the work of the evaluation of the microbiological, bacteriological and parasitological quality of wastewater from the city of Conakry.[7] The equipment used consists of: GPS, conductivity meter, pH meter, COD meter, BOD meter, turbidimeter, spectrophotometer, autoclave and incubator.

2.2 Methods

We took five (5) samples per municipality, i.e. twenty-five (25) for the five municipalities (Kaloum, Dixinn, Matam, Matoto and Ratoma) of Conakry a volume of (500 ml) of wastewater on the surface and in depth between 30 and 50 cm depending on the nature of the sites, in sterile bottles.

Temperature and pH were determined at the sampling sites with a portable pH meter. Electrical conductivity (EC) with the HANA LF 330 conductivity meter, dissolved oxygen (O_2) with a Model DO210 Oximeter, turbidity (NTU) with the Hach 2100 p turbidimeter on site, Suspended Solids (MeS) by the method centrifugation, the chemical oxygen demand (COD) by COD meter, the biological oxygen demand (BOD_5) by a BOD meter, total nitrogen (Ntot) is measured by autoclaving. Nitrite (NO_2^-), Nitrates (NO_3^-), Ammonium ions (NH_4^+) and Phosphates (PO_4^{3-}) were measured using the DR 2800 spectrophotometer, requiring reagents specific to each of them.[8,9,10] The photos in Figure 1 show some sample collection sites.

Photo 1: Matoto Yimbayah Market.   **Photo 2: Matam Lido Corniche.**   **Photo 3: Dixinn Melinium.**

Figure 1: Sample collection.

3. RESULTS AND DISCUSSION

3.1 Results

The average values of the physico-chemical parameters of raw domestic wastewater per municipality of the city of Conakry assessed are given in Table 1.

Table 1: Physico-chemical parameters of domestic raw wastewater from Conakry.

Paramters	Kaloum	Dixinn	Matam	Ratoma	Matoto	Moyenne
T(°C)	30,2	28,5	29	27	26,8	28,3
pH	7,5	6,8	8	7,4	6,7	7,28
CE (µs/cm)	750	1580	1750	1250	860	1238
Turb (NTU)	405,45	567,5	745,77	250,6	150,6	423,98
MeS (mg/L)	285	310	420	265	270	310
O2 (mg/L)	1,8	2,5	2,1	1,5	2,2	2,02
DCO (mgO2/L)	205,75	185,85	225,4	95,7	70,23	156,59
DBO5 (mgO2/L)	180,6	220,1	150,76	50,75	88,74	138,19
NO2- (mg/L)	0,03	0,02	0,04	0,03	0,08	0,04
NO3- (mg/L)	2,54	1,6	4,5	0,96	1,2	2,16
NH4+ (mg/L)	45,7	47,5	42,1	38,7	54,1	45,62
Ntot (mg/L)	95,5	85,4	115,8	90,7	75,18	92,52
PO43-(mg/L)	0,25	0,3	0,18	0,15	0,4	0,26
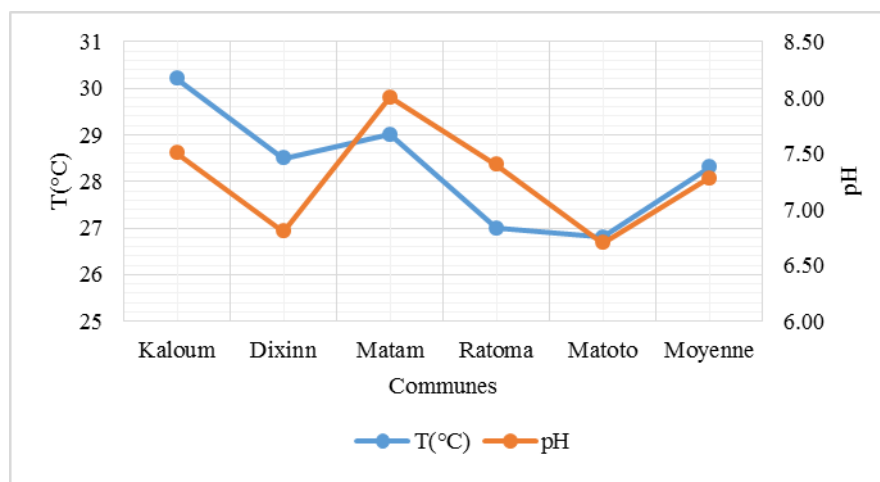
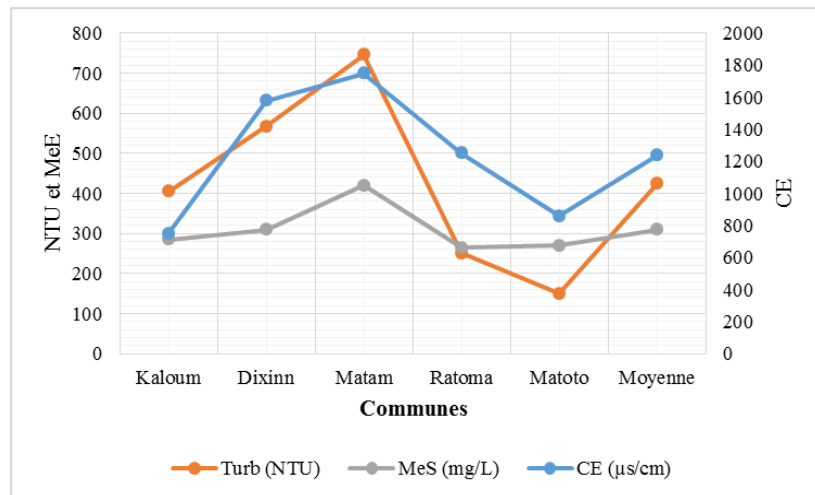**Figure 2: Temperature and pH.**

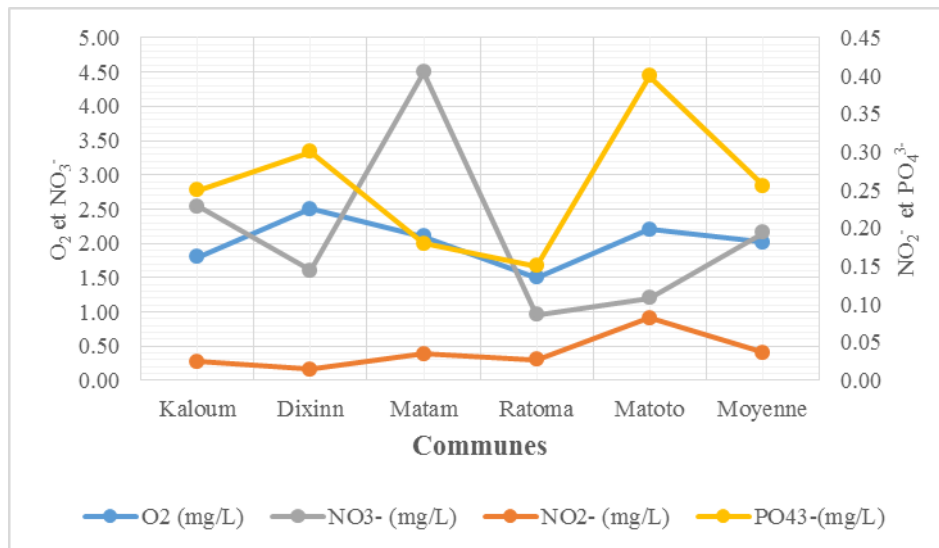**Figure 3: Turbidity (NTU), Suspended Solids (MeS) and Electrical Conductivity (EC).**

Figure 4: Dissolved oxygen (O$_2$), Nitrates (NO$_3^-$), Nitrite (NO$_2^-$), Phosphates (PO$_4^{3-}$).
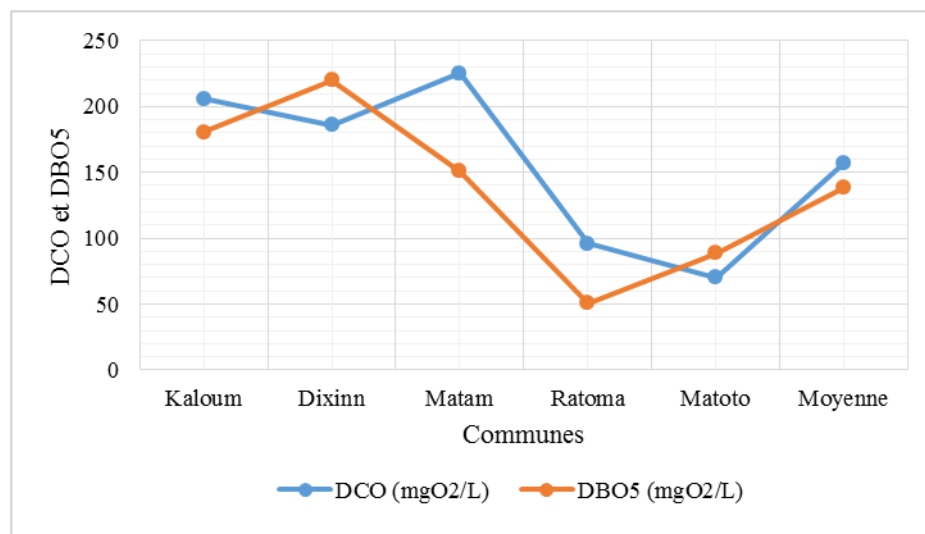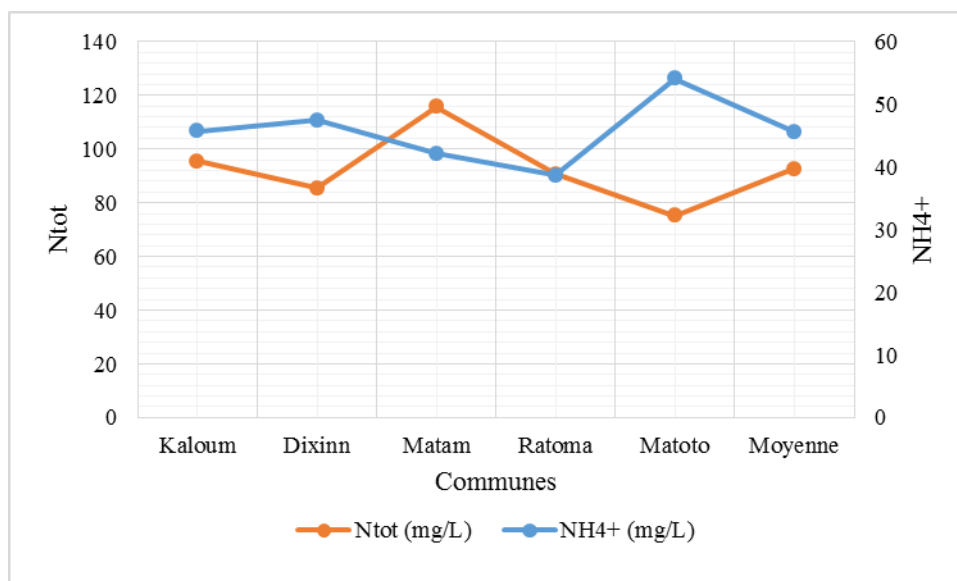

Figure 5: Chemical oxygen demand (COD) Biological oxygen demand (BOD5).

Figure 6: Total nitrogen (Ntot) and Ammonium ions (NH4+).

3.2 Talks

The twenty-five (25) samples of domestic wastewater from the different municipalities of Conakry present odors and colors (brown, yellowish and black) depending on the site, which shows that all these waters are polluted.

3.2.1 Temperature

Temperature is an important physical parameter that influences the chemical and biochemical characteristics of the water body. The temperature of the samples of wastewater taken in the various communes of Conakry is between 26.80°C and 30.20°C; with an average of 28.30°C (Table 1). The temperature values of the wastewater recorded are relatively higher and lower than 30°C, considered as the limit value for direct discharge into the receiving environment.[11] Similarly, these values are below 35°C, considered as an indicative limit value for water intended for irrigation.[12]

3.2.2 pH

It indicates the alkalinity of the wastewater. The average pH values of the samples are close to neutral, they are between 6.70 and 8.00; respectively for Matoto and Matam (Figure 2), with an average for the city of Conakry of 7.28 (Table 1). This average value is in the optimum pH range (6.5 to 7.5) for the growth of microorganisms.[9]

3.2.3 Turbidity (NTU)

The measurement of the turbidity of water is related to its optical property/transparency. Turbidity is influenced by the components present in the water sample. The low turbidity value indicates the absence of iron contamination and suspended organic contaminants.

The average turbidity values (NTU) of raw wastewater from the city of Conakry are respectively: Matam (745.77); Dixinn (567.50); Kaloum (405.45); Ratoma (250.60) and Matoto (150.60). With an average for the whole city of 423.98 NTU. These values demonstrate prior treatment of Conakry wastewater before use. According to WHO guidelines, a turbidity below 5 NTU is favorable for consumption.[13]

3.2.4 Electrical Conductivity (EC)

It reflects the degree of overall mineralization, it tells us about the salinity rate. The average values of electrical conductivity recorded are between 750μs/cm and 1750μs/cm, respectively in Kaloum and Matam (figure 3), with 1238μs/cm as the average value (Table 1). The results obtained highlight a more or less significant variation in the different municipalities of the mineralization expressed in average conductivity. The average values are less than 2700μs/cm, considered as the limit value for direct discharge into the receiving environment.[11]

3.2.5 Suspended Matter (MeS) and Dissolved Oxygen (O_2)

The concentrations of MeS in the wastewater analyzed vary between 265mg/l and 420mg/l, respectively at Ratoma and Matam (figure 3), with an average of 310mg/L (Table 1). The oxygenation status of these discharges shows that the minimum and maximum extreme values of the dissolved oxygen content are 1.50mg/L at Ratoma and 2.50mg/L at Dixinn (figure 3), with an average concentration of 2.02mg/L (Table 1). The results obtained are less than 2000 mg/L. Thus, these waters can be used for irrigation without danger. These average values of MeS in the wastewater analyzed are higher than the values set by certain environmental standards (NS 05-061, 2001).[11] The presence of dissolved oxygen conditions the aerobic degradation reactions of organic matter and more generally the biological balance of water environments.

3.2.6 Biological Oxygen Demand (BOD_5) and Chemical Oxygen Demand (COD)

During this study period, the BOD_5 values recorded vary from 50.75mg/L (Ratoma) to 220.10mg/L (Dixinn) with an average value of 138.19 mg/L. Similarly, the COD values are

not negligible, they vary from 50.75 mg/L (Ratoma) to 225.40 mg/L, with an average of 156.59 mg/L (Table 1). The high BOD_5 values could be explained by the abundance of organic matter in the analyzed waters.

The values of the COD/BOD_5 ratio vary from 0.79 (Dixinn) to 1.89 (Ratoma) with an average of 1.13 less than 3; which deduces that the wastewater analyzed is predominantly domestic.[14] The results of this report are an indication of the importance of pollutants with little or no biodegradability. Thus, the results show that; whatever the organic load of the analyzed waters (high), they are easily biodegradable.

The BOD5/COD ratio often characterizes industrial pollution. It provides information on the origin of wastewater pollution and its treatment options. For the present study, the average value of this ratio is relatively high, around 0.88. This is the general case for releases loaded with organic matter.[15] This organic load makes this wastewater quite unstable, i.e. it will quickly evolve into "digested" forms with the risk of odors being released.

3.2.7 Nitrogen, Nitrates, Nitrite and Phosphorus

Nitrogen present in wastewater can be organic or inorganic. Organic nitrogen is mainly a constituent of proteins, polypeptides, amino acids and urea. Mineral nitrogen which includes ammonium (NH_4^+), Nitrite (NO_2^-) and Nitrates (NO_3^-) constitutes the major part of total nitrogen. The values of total nitrogen (Not) vary between 75.18mg/L and 115.80mg/L, respectively in Matoto and Matam (Figure 4), with an average of 92.52mg/L (Table 1). These values are relatively consistent with those of other authors.[16]

Nitrates, like other nitrogenous forms, evolve very quickly in the natural environment according to the nitrogen cycle. The nitrate contents of domestic wastewater in Conakry vary from 0.96mg/L (Ratoma) to 4.50mg/L (Matam), with an average of 2.16mg/L (Figure 4).

Nitrites are an important step in the metabolization of nitrogen compounds, they are also part of the nitrogen cycle between ammonium and nitrates. Nitrites generally come either from an incomplete degradation of Ammonia or from a reduction of Nitrates. The average levels of Nitrite recorded in the samples vary from 0.02mg/L (Dixinn) to 0.08mg/L (Matoto), with an average of 0.04mg/L (Figure 4). The comparison of the average nitrate concentrations in the wastewater analyzed with the quality standard for water intended for irrigation shows that

these concentrations are much lower than 50 mg/L, which makes it possible to deduce that these effluents are acceptable for the crop irrigation.[17,18]

Phosphorus compounds (PO_4^{3-}) exist in natural waters and wastewater in different forms, namely soluble orthophosphates, water-soluble phosphates and organophosphate derivatives. The levels recorded vary from 0.15mg/L (Ratoma) to 0.40mg/L (Matoto), with an average of 0.26 mg/L (Table 1).

4. CONCLUSION

Environmental concern presupposes a certain basic dynamism aimed at safeguarding ecosystems against all types of pollution and better management of the environment. Domestic wastewater from the city of Conakry has major physicochemical characteristics of pollution which relatively exceed the general limit values for direct and indirect discharges into the receiving environment, which represents a risk of environmental pollution, hence the need for a adequate treatment of this raw wastewater. The analyzes were carried out on twenty-five (25) samples of domestic wastewater, including five (5) per commune of Conakry. The various parameters studied are: temperature and pH, electrical conductivity (EC), dissolved oxygen (O2), turbidity (NTU), Suspended Solids (MeS), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD5) Total nitrogen (Ntot), nitrites (NO2-), nitrates (NO3-), ammonium ions (NH4+) and phosphates (PO43-). Research will be continued in order to carry out an adequate treatment trial for this wastewater for its recovery.

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