Evaluation of the physicochemical parameters of domestic wastewater treated by the slow filtration technique on charcoal, sand and Gravel of the city of Conakry - Guinea

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ABSTRACT

This study is a continuation of our research work on wastewater management. Its main objective is to determine certain physicochemical parameters of samples of domestic wastewater treated by the technique of slow filtration on charcoal, sand and gravel, from the five municipalities of the city of Conakry. It took place during the months of September and October 2021. The physicochemical parameters of the samples after treatment varied as follows: temperature from 28.30°C to 27°C; the pH from 7.28 to 6.96; electrical conductivity (EC) from 1238µs/cm to 1280µs/cm; turbidity 423.98 NTU to 17.96 NTU; alkalinity (CaCO3) from 203.60 mg/l to 135.40 mg/l; Suspended Solids (MeS) from 310 mg/l to 29 mg/l; dissolved oxygen (O2) from 2.02 mg/l to 4.44 mg/l; the Biological Oxygen Demand (BOD5) from 156.59mgO2/l to 68.50mgO2/L; Chemical oxygen demand (COD) from 138.19mgO2/l to 65.50mgO2/L; Nitrites (NO2-) 0.04 mg/l to 0.0019mg/l; Nitrates (NO3-) from 2.16mg/l to 0.02mg/l; ammonium (NH4+) from 45.62mg/l to 12.40mg/l and phosphates (PO43) from 0.26mg/l to 0.0008mg/l. The results obtained showed that the technique of wastewater treatment by filtration on charcoal, sand and gravel made it possible to improve the quality of the wastewater samples. Thus, they can be discharged into receiving environments or be reused in various fields, such as: washing machines, flushing toilets, gardening, watering, market gardening, irrigation, etc. This treatment technique is local, economic and environmental, so it remains to be encouraged and popularized in rural and urban areas.

Keywords: *Physicochemicals, wastewater, filtration, coal, sand and gravel.*

1. Introduction

Urban wastewater is domestic wastewater or the mixture of domestic wastewater and industrial wastewater and/or runoff water. They are of various natures and are generally discharged into the receiving environment without treatment in most large cities in developing countries [1].

Urban wastewater according to its origins is characterized by a variability in flow andin composing. These variations are a function of the food habits of the populations, of the rural or urban environment of their origin, of the density of the population, of the mode and standard of living of the populations, of the flow conditions in the sanitation network as well as of the rainfall events [2].

Water holds an important place in our lives by being found in all the activities that punctuate our daily lives. However, its different uses for needs such as those domestic, industrial, artisanal, agricultural, etc., are sources of production wastewater, this wastewater due to its physicochemical and bacteriological qualities
altered, deserve to be treated before being released into the environment [3]. The non-treatment and/or the inadequate treatment of the latter is one of the main causes of the pollution of water resources, both in developing and developed countries. This state of affairs results in a degradation of the quality of the receiving environments and thus leads to a decline in the productivity of aquatic ecosystems and the deterioration of the living environment of local populations [4].

Treating wastewater before discharge is an imperative that presents a double challenge, that of limiting pollution of the environment and that of preserving public health. So having for main objective of ensuring a sustainable environment for all, water treatment requires the establishment of functional sanitation infrastructures and the optimization of their performance [5].
Thus, the present study has the general objective of evaluating the physicochemical parameters of domestic wastewater from the city of Conakry treated by slow filtration on charcoal, sand and gravel.

2. Materials and methods

2.1 Hardware

This study is a continuation of our research work on the determination of the microbiological, bacteriological and parasitological loads of wastewater from the city of Conakry [6]. The equipment used consists of: conductivity meter, pH meter, COD meter, BOD meter, turbidimeter, spectrophotometer, autoclave and incubator [7].
The experimental devices for processing wastewater samples from the five municipalities of the city of Conakry are: polystyrene buckets with a capacity of 20 liters, cylindrical in shape with a drain tap for recovering the treated water. Filtration materials are: coarse and fine grain gravel, coal and fine sand. The wastewater samples were taken from twenty-five (25) sites in the five communes of the city of Conakry, i.e. five (5) samples per commune [8].

2.2 Methods

2.2.1 Realization of the treatment device

Five (5) devices were made, each of which consists of a 20-litre bucket that contains the waste water and four other 4-litre containers to collect the treated water. The main characteristics of the filter medium are: the effective diameter, the coefficient of uniformity, the relative density, the dry unit mass and the porosity. There are other characteristics that are much more difficult to measure, such as grain shape and specific surface area. The effective diameter corresponds to the size of the meshes of the sieve which allow 10% of the mass of the sample to pass [8, 9].

2.2.2 Physicochemical analyzes

Temperature and pH were determined with a portable pH meter. Electrical conductivity (EC) with the HANA LF 330 conductivity meter, dissolved oxygen (O2) with a Model DO210 Oximeter, turbidity (NTU) with the Hach 2100p turbidimeter, Suspended Solids (MeS) by the centrifugation method, the chemical oxygen demand (COD) by COD meter, the biological oxygen demand (BOD5) by a BOD meter, the total Nitrogen (Ntot) is measured by autoclaving. Nitrite (NO2-) Nitrate (NO3-), Alkalinity (CaCO3) is determined by the counting method of pre-dosed pellets, Ammonium ions (NH4+) and Phosphates (PO43-) were measured through the DR 2800 spectrophotometer, requiring reagents specific to each of them [7, 8, 10, 11].

3. Results and discussion

3.1 Results

The average values of the physicochemical parameters of raw domestic wastewater from the city of Conakry **treated by the filtration technique are given in Table 1.**

Table 1: Physicochemical parameters of treated raw domestic wastewater from Conakry

Parameters	Kaloum		Dixinn		Matam		Ratoma		Matoto		Moyenne	
	Untreated	Processed	Untreated	Processed	Untreated	Processed	Untreated	Processed	Untreated	Processed	Untreated	Processed
T(°C)	30.2	30	28.5	28	29	26	27	25	26.8	26	28.30	27.00
pH	7.5	7.3	6.8	6.5	8	7.5	7.4	7	6.7	6,5	7.28	6.96
CE (µs/cm)	750	800	1580	1620	1750	1780	1250	1300	860	900	1238	1280
Turb (NTU)	405.5	15.7	567.5	20.5	745.8	35.8	250.6	10.3	150.6	7,5	423.98	17.96
$CaCO_3$ (mg/L)	205	150	220	160	185	120	240	157	168	90	203.60	135.40
MeS (mg/L)	285	20	310	32	420	40	265	25	270	28	310	29.00
O_2 (mg/L)	1.80	4.20	2.50	5.70	2.10	4.30	1.50	3.50	2.20	4.50	2.02	4.44
DCO (mgO_2/L)	205.8	102.5	185.9	90	225.4	95	95.7	30	70.23	25	156.59	68.50
DBO_5 (mgO_2/L)	180.6	80	220.1	110	150,8	75.5	50.75	20	88.74	42	138.19	65.50
NO_2^- (mg/L)	0.03	0.001	0.02	0.001	0.04	0.002	0.03	0,0015	0.08	0.004	0.04	0.0019
NO_3^- (mg/L)	2.54	0.015	1.6	0.01	4.5	0.02	0.96	0.03	1.2	0.005	2.16	0.02
NH_4^+ (mg/L)	45.7	12	47.5	15	42.1	10	38.7	8	54.1	17	45.62	12.40
PO_4^{3-}(mg/L)	0.25	0.002	0.3	0.0015	0.18	0.0001	0.15	0.0001	0.4	0.0002	0.26	0.0008

The results of Table 1 are illustrated by the diagrams of Figures 1 to 6, for their interpretations, analyzes and discussions.

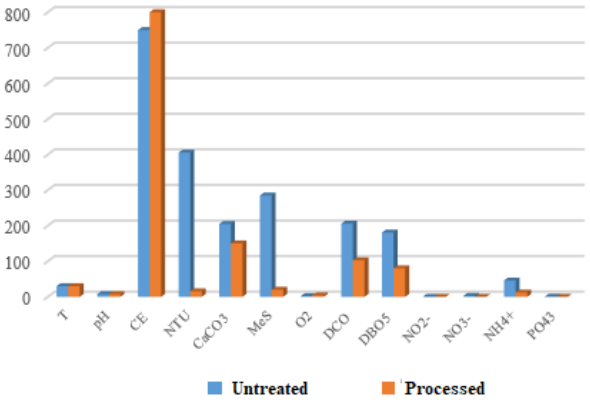

Figure 1 : Physicochemical parameters of treated wastewater from Kaloum

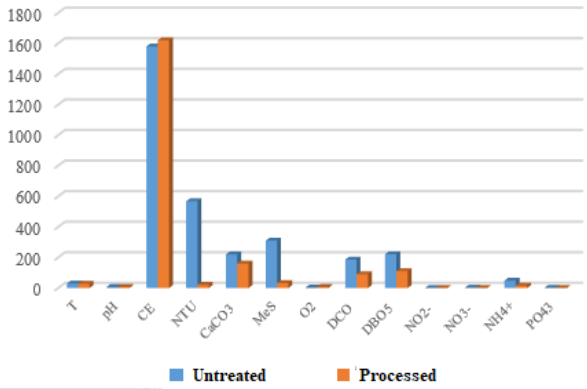

Figure 2 : Physicochemical parameters of treated wastewater from Dixinn

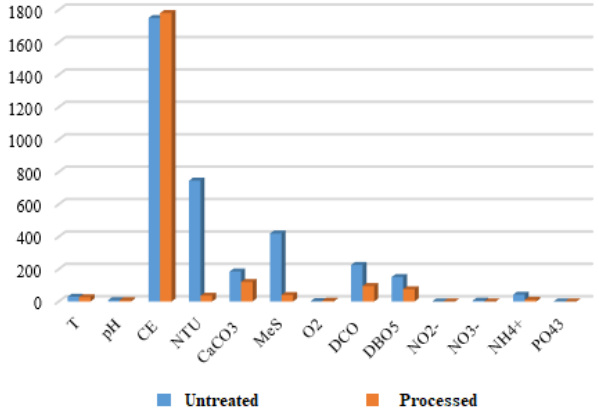

Figure 3 : Physicochemical parameters of treated wastewater from Matam

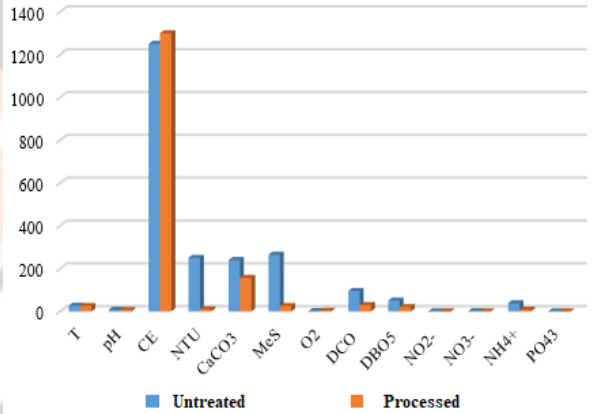

Figure 4 : Physicochemical parameters of Ratoma treated wastewater

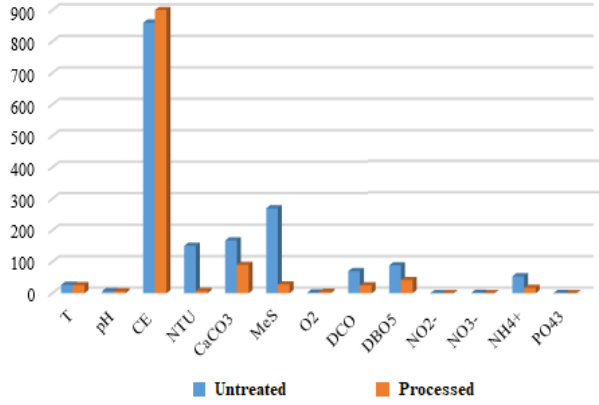

Figure 5 : Physicochemical parameters of treated wastewater from Matoto

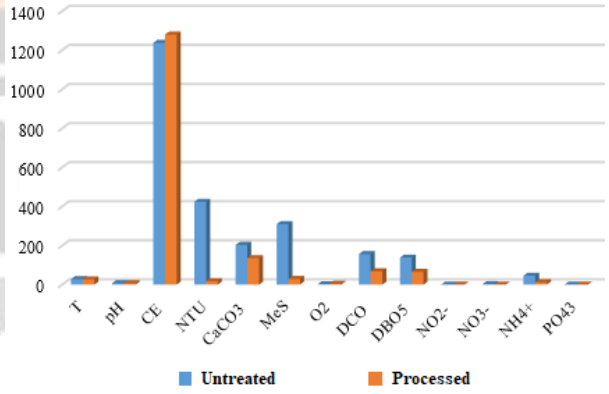

Figure 6 : Average values of physicochemical parameters of treated wastewater from the five municipalities of Conakry

3.2 Discusssion

The results obtained after treatment of samples of domestic wastewater from the city of Conakry by the technique of slow filtration on charcoal, sand and gravel (figures 1 to 5) show a considerable reduction in certain chemical substances after filtration, such as: NO2-NO3-, NH4+, PO43-, NTU and MeS. However, certain physicochemical parameters (temperature, pH, EC, O2, COD, BOD5 and CaCO3) varied slightly, this can be explained by the fact that filtration on charcoal, sand and gravel is not effective in making water drinkable. , this means that the water requires a treatment chain to make the water comply with drinking water standards [12]. The diagrams in Figure 6 show the variations in the average values of the physico-chemical parameters of

wastewater before and after treatment in the five municipalities of Conakry. We observe that: the temperature varied from 28.30°C to 27°C; the pH from 7.28 to 6.96; electrical conductivity (EC) from 1238µs/cm to 1280µs/cm; turbidity 423.98 NTU to 17.96 NTU; alkalinity (CaCO3) from 203.60 mg/l to 135.40 mg/l; Suspended Solids (MeS) from 310 mg/l to 29 mg/l; dissolved oxygen (O2) from 2.02 mg/l to 4.44 mg/l; the Biological Oxygen Demand (BOD5) from 156.59mgO2/L to 68.50mgO2/L; Chemical oxygen demand (COD) from 138.19mgO2/L to 65.50mgO2/L; Nitrites (NO2-) 0.04 mg/l to 0.0019mg/l; Nitrates (NO3-) from 2.16mg/l to 0.02mg/l; ammonium (NH4+) from 45.62mg/l to 12.40mg/l and phosphates (PO43) from 0.26mg/l to 0.0008mg/l (Table 1). These results show that the samples of treated water are within the standards for discharge into the receiving environment without danger and can be used without danger in agriculture (watering or irrigation), in washing machinery and for flushing. [3, 5, 13].

4. Conclusion

The treatment of domestic wastewater by the technique of slow filtration on carbon, sand and gravel is an approach to be encouraged and popularized in the urban and rural areas of the country. Reusing treated domestic water will solve many wastewater related problems. It can lead to the saving of water resources and solve some environmental problems caused by these waters. Treated water can be used for several purposes such as conservation, industrial use or recovery of wastewater effluent in cooling systems, boiler feed, reuse in agriculture, horticulture, sericulture, lawn watering, etc. This research makes it possible to limit the pollution of the environment and that of the preservation of public health. It therefore remains to be continued within the framework of the establishment of efficient infrastructures for the management and treatment of wastewater in an optimal manner.

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