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Evaluation of the Kossodo Wastewater Treatment Plant Efficiency in Burkina Faso, West Africa

Issoufou Ouedraogo[1,2]*, Claude Arnaud Sié Kambou[1], Michelline Marie Regina Kansole[1,2], César Millogo[3,2], Fotié Rodrigue[2] and Yacouba Konaté[4]

[1]University Yembila-Abdoulaye-TOGUYENI, BP 54 Fada N'Gourma, Burkina Faso
[2] Laboratoire géoscience et environnement minier (LaGE), Département des Sciences de la Terre, Université Joseph KI-ZERBO, Ouagadougou, Burkina Fas
[3]UFR/Sciences Appliquées et Technologies, Université Daniel OUEZZIN-COULIBALY, BP 139, Dédougou, Burkina Faso
[4]Water, Hydro-Systems and Agriculture Laboratory (LEHSA), International Institute of Water and Environmental Engineering (2iE), Ouagadougou, Burkina Faso

Correspondence Author:: Issoufou Ouedraogo, University Yembila-Abdoulaye-TOGUYENI, BP 54 Fada N'Gourma, Burkina Faso. Laboratoire géoscience et environnement minier (LaGE), Département des Sciences de la Terre, Université Joseph KI-ZERBO, Ouagadougou, Burkina Faso. E-mail: ouedraogo.issoufou03@gmail.com

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ABSTRACT: Background: In 2004, Burkina Faso established the Kossodo wastewater treatment facility, utilizing a lagoon system. The plant was designed as both a cost-effective and efficient solution, with the additional benefit of enabling the reuse of treated wastewater. Objective: This study aims to examine the current state of its operation, assess the wastewater purification performance, and suggest ways of improving the quality of the effluent with a view to its possible reuse. To achieve this objective, bi-weekly samples were taken over six weeks. Composite sampling was carried out for the raw water, while spot sampling was carried out for the effluent from the maturation basin. Results: The pollution indicators examined consisted of Chemical Oxygen Demand (COD), filtered COD, 5-day Biological Oxygen Demand (BOD5), Suspended Solids (SS), ammonia nitrogen, nitrates, total phosphorus, and ortho-phosphates. As regards microbial contamination, fecal coliforms and specifically Escherichia Coli were tested. The removal rates for COD and BOD5 were recorded at 20.24% and 82%, respectively. Despite this, the average concentration of TSS in the treated water remained relatively high at 266.72 mg/l, surpassing Burkina Faso's standards for the discharge of treated wastewater into surface water, which are set at 150 mg/l for unrestricted reuse. In addition, pathogen elimination proved to be very poor, or even non-existent, with yields that were sometimes negative. The inadequate purification performance of fecal contamination indicators is reflected in residual concentrations above 2000 CFU/100 ml, well above the standard recommended for discharge into the natural environment in Burkina Faso. Conclusion: It is therefore crucial to improve the operation of this plant to guarantee a better quality of treated effluent, in compliance with current standards.

Keywords: *Effluents, Discharge standards, Microbiological quality, wastewater treatment plant, Kossodo, Ouagadougou, Burkina Faso*

INTRODUCTION

In a Sahelian country like Burkina Faso, the preservation of water resources is a primordial subject at the heart of the decision-making framework through the various national plans and programs. Concerning the section on wastewater management, particular attention is paid to their treatment to contribute to the well-being of populations, by limiting pollution of receiving environments and promoting their reuse. Also, by further accentuating efforts in this direction, the Ministry of Water and Sanitation developed 2015 the National Wastewater and Excreta Sanitation Program (PN-AEUE) for 2030, which is the reference document on wastewater sanitation for a vision of sustainable development (Kakou, 2021).

Thus, considering the need to better manage wastewater and excreta resulted in Ouagadougou in Burkina Faso through the construction and operation of numerous public and private treatment plants, intended to treat wastewater Domestic and/or industrial. These include microphyte lagoon wastewater treatment plants, and activated sludge plants, whose treated effluents have various purposes, namely, reuse in urban agriculture, watering of green spaces, or release into the natural environment. Consequently, multiple public and private wastewater treatment facilities have been constructed to treat urban wastewater and excreta, following the establishment of a strategic sanitation plan for the city of Ouagadougou (PSAO) by ONEA in 1995 (Kakou, 2021).

An example of this is the wastewater treatment plant (WWTP) established in the Kossodo district in 2004, located on the outskirts of Ouagadougou and managed by the "Office National de l'Eau et de l'Assainissement" (ONEA). Built to allow the sanitation of the city of Ouagadougou, the station has difficulty meeting expectations because wastewater reaches it from the Brasserie du Burkina Faso (BRAKINA), the slaughterhouse, the Yalgado OUEDRAOGO hospital, the urban center of Ouagadougou and some hotels in the city are often very busy; this makes processing difficult and hurts the performance of the station. To better manage the operation of its installation, the evaluation of this system both scientifically and technically appears to be a success factor in achieving the objective of developing sanitation in Burkina Faso.

The primary aim of this study is to assess the purification effectiveness of the physico-chemical treatment processes at the Kossodo wastewater treatment plant and to suggest improvements for enhancing the efficiency of pollutant removal from the treated water prior to its discharge or reuse.

2 MATERIALS AND METHODS

2.1 General presentation of the Kossodo Wastewater Treatment Plant (WWTP)

Built in 2004, the Kossodo WWTP operates with a microphyte lagoon system. It covers a total area of ten (10) ha. It has an estimated treatment capacity of 140,000 population equivalents with a total volume of approximately 180,000 m3 (Ague, 2021).

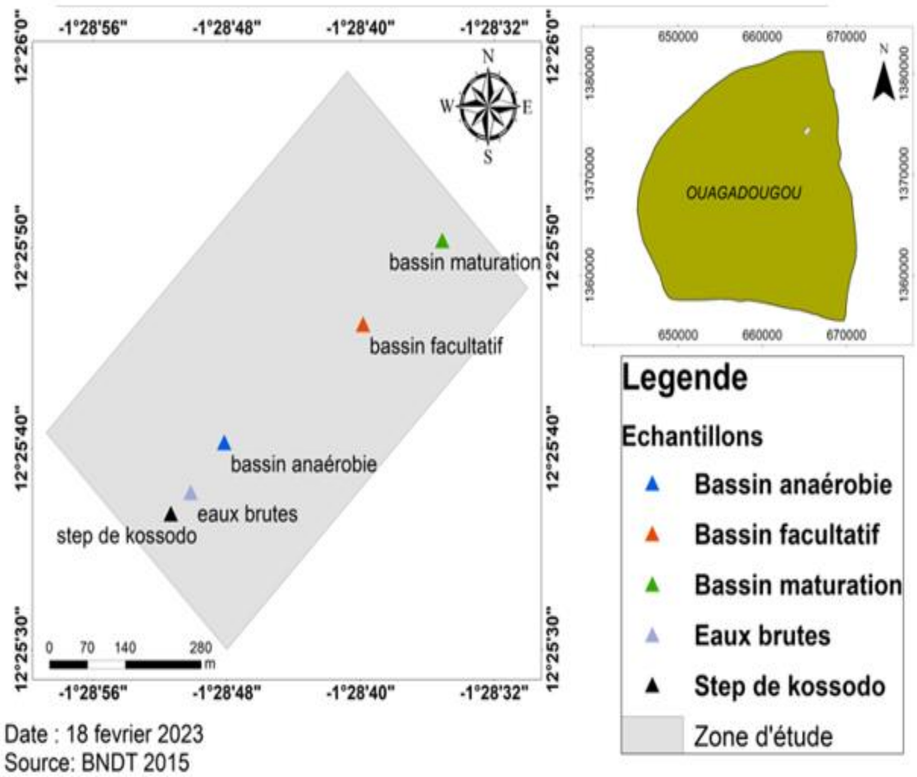

Figure 1: Sampling points and study area

The microphyte lagoon system relies on natural self-purification processes from microscopic algae. Microorganisms degrade organic matter by transforming it into mineral elements essential to their survival. The treatment of wastewater by lagoons consists of consecutive basins through which the water passes by gravity and respecting a certain residence time. Typically, the first pond in the series is anaerobic, while the second functions as a facultative pond. Following these, maturation ponds may be included, depending on the quality of the final effluent required, which is determined by its intended use (Peña, Miguel, 2004). The following table presents the composition of the basins of the Kossodo wastewater treatment plant.

Table 1: Characteristics of the basins of the Kossodo Lagoon station

Designation	Volume (m^3)	Depth (m)
▲ Anaerobic Basin (AB3)	10235	4.7
▲ Facultative Basin (FB2)	51500	2.5
△ Maturation Basin 1 (MB1)	27000	2.7
△ Maturation Basin 2 (MB2)	6850	2.7
△ Maturation Basin 3 (MB3)	6850	2.7

2.2 Sampling technique

Sampling was carried out occasionally on the site at the entrance and exit of the Wastewater Treatment Plant (WWTP) with a twice-weekly measurement frequency over six weeks. The samples were taken with 1L plastic bottles for the analysis of physicochemical parameters and sterile 1L glass bottles for the analysis of microbiological parameters.

Physico-chemical parameters

Global physicochemical parameters, including temperature, pH, electrical conductivity, and turbidity, were measured in situ using a pH meter, a conductivity meter, and a turbidimeter on-site.

Organic pollution measurement parameters

The parameters measured are essentially Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Suspended Solids (SS). These parameters were measured on point samples at the inlet and outlet of the Kossodo Wastewater Treatment Plant.

Biological Oxygen Demand: BOD_5

The Biological Oxygen Demand (BOD5) indicates the amount of oxygen required to biologically decompose the organic matter found in the effluent.

Chemical Oxygen Demand: COD

It quantifies the amount of dissolved oxygen needed to chemically oxidize all oxidizable substances present in an effluent. The Chemical Oxygen Demand (COD) is determined through hot oxidation in a highly acidic environment for two hours (2h), with potassium dichromate being the most commonly used oxidizing agent.

Suspended Solids: SS

The method used for measuring Suspended Solids (SS) involves differential weighing through filter filtration and drying at a temperature of 105°C, following standard procedures.

2.3 Analysis Methodology

The selected parameters are those that most effectively evaluate water quality, specifically their potential impact on the receiving aquatic environment, including pH, temperature, Chemical Oxygen Demand (COD), and Biological Oxygen Demand (BOD), etc. The different physicochemical parameters were analyzed according to AFNOR standardized methods. The laboratory analyses also involved investigating the microorganisms present in the samples collected at the Water, Hydro-system, and Agriculture Laboratory of the International Institute of Water and Environmental Engineering (2iE).

2.4 Statistical Analysis

The data gathered during the bi-weekly sampling, which included physicochemical parameters (temperature, pH, conductivity, turbidity) and measurements of organic pollution (Biological Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Suspended Solids (SS)), underwent statistical analysis. Although the Statistical Package for the Social Sciences (SPSS) was considered for this analysis, Excel was the primary tool used.

The statistical tests conducted included analysis of variance (ANOVA) to assess significant differences between the samples collected at the inlet and outlet of the Kossodo wastewater treatment plant (WWTP). Correlation tests were also performed using Excel to examine the relationships among various physicochemical parameters, such as BOD5 and COD. This methodology aimed to enhance the understanding of the interactions between these variables and their influence on the quality of the treated effluent. The results are presented with a 95% confidence interval, with $p < 0.05$ values regarded as statistically significant.

3 RESULTS AND DISCUSSIONS

3.1 Characteristics of wastewater from the Kossodo plant

Physical parameters, including pH, electrical conductivity, and temperature, are factors that affect bacterial activity throughout the effluent purification process. The organic pollutants evaluated during our observation period include Suspended Solids (SS) and Chemical Oxygen Demand (COD).

Table 2: studied physico-chemical and organic parameters.

Parameters	Unit	n[1]	Raw Water			Treated Water		
-			Average	Interval (Min-Max)	Standard deviation	Average	Interval (Min-Max)	Standard deviation
Ph		10	7	6.63 -10.57	1	8	8.12 – 8.85	0
Conductivity	(µS/cm)	10	1984	1624 - 2480	285	2050	1940 - 2128	63
Temperature	°C	10	31	25.2 – 34.1	3	29	22.7 – 32.7	3
Turbidity	NTU	10	259	36.7 - 411	125	121	30.5 - 218	81
SS	mg/L	10	455	5 - 840	290	254	11.6 - 500	140
Simple COD	mg/L	10	1110	1000-1286	14	741	575-852	1
Filtered COD	mg/L	10	30	17076	15	17	14277	1
$N-NH_4^+$	mg/L	10	10	1.2 – 26.8	7	6	1.9 – 15.2	4
$N-NO_3^-$	mg/L	10	12	43313	3	20	33055	25
$N-PO_4^{3-}$	mg/L	10	27	13 – 43.4	11	31	13.6 – 41.6	8
NTK	mg/L	10	9–5.24	174.49 – 2123.33	613	767	310 - 1820	464
CF	ufc/100ml	10	6.5 107	1.9 104- 2.2 108	8.3 107	3.4 105	1.5 103 – 2.6 106	8.05 105
E Coli	*ufc/100ml*	10	7.7 105	2 103- 4.8 106	1.5 106	6.9 103	1.5 103- 2.1 104	7

3.2 Evaluation of parameters at the Kossodo Wastewater Treatment Plant (**WWTP)**

pH variation

The pH values ranging from 6.10 to 10.57 indicate a significant variability in the effluent entering the station (anaerobic basin). This fluctuation in the pH of raw wastewater is primarily associated with the characteristics of the wastewater from the brewery. Specifically, the lower pH values (minimum pH of 6.10) can be attributed to the discharge of acidic water resulting from the brewery's use of phosphoric acid for tank disinfection. In contrast, the very high pH values (maximum pH of 10.57) stem from the use of caustic soda for washing tanks and bottles in the brewery. Furthermore, we note a rise in pH to 8 in the facultative and maturation basins. It reaches maximum values of around 9 in the effluents leaving the maturation basins. Figure 1 shows the evolution of the pH values of the raw influent and the outlet effluent from the maturation basin.

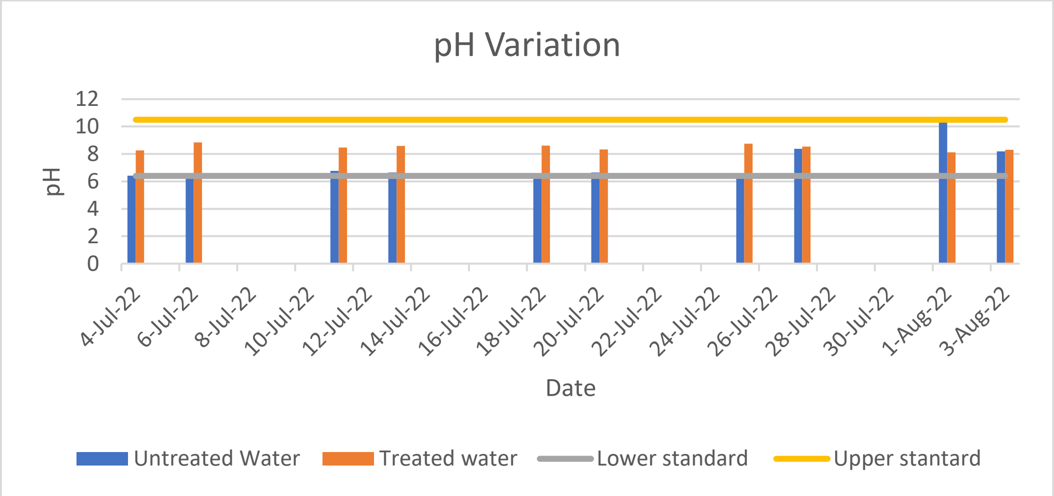

Figure 2: Variation of hydrogen potential (pH)

Temperature variation

Figure 2 illustrates the temperatures of the influent, which exhibit considerable variability, ranging from a minimum of 25.2°C to a maximum of 34.1°C. The average temperature of the raw influent is 31.08°C, which is notably higher than the average temperature of the outlet effluent at 28.78°C. In general, the variations in temperature intervals are indicative of the local climatic conditions impact.

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[1] *n: number of samples; CF: Fecal Coliform; E. coli: Escherichia Coli*

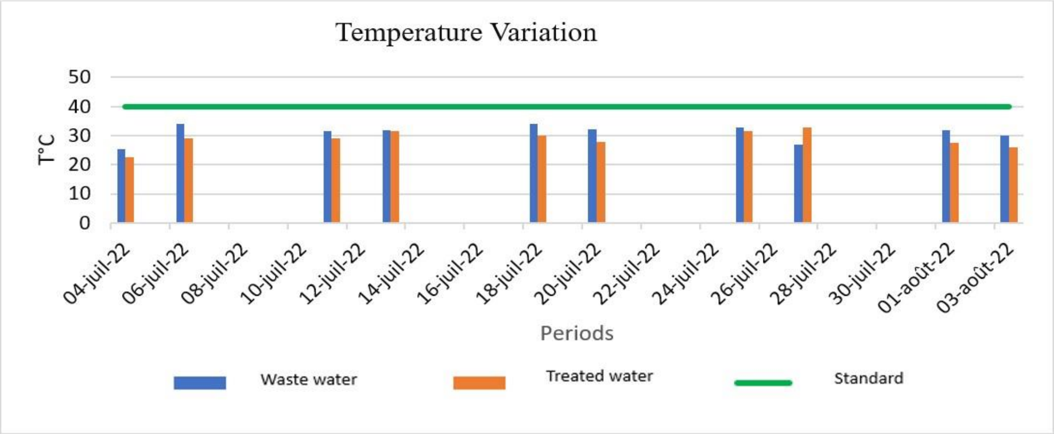

Figure 3: Temperature variation

Variation in conductivity

The conductivities of the influents at the wastewater treatment plant (WWTP) exhibit significant variability and are relatively high, ranging from 1624 µS/cm to 2480 µS/cm, with an average value of 1983.5 µS/cm. In contrast, the conductivities in the other basins are also high on average but display less variability, with an average conductivity of 2049.5 µS/cm measured at the outlet of the maturation basin as shown in Figure 4, which illustrates the conductivity variation.

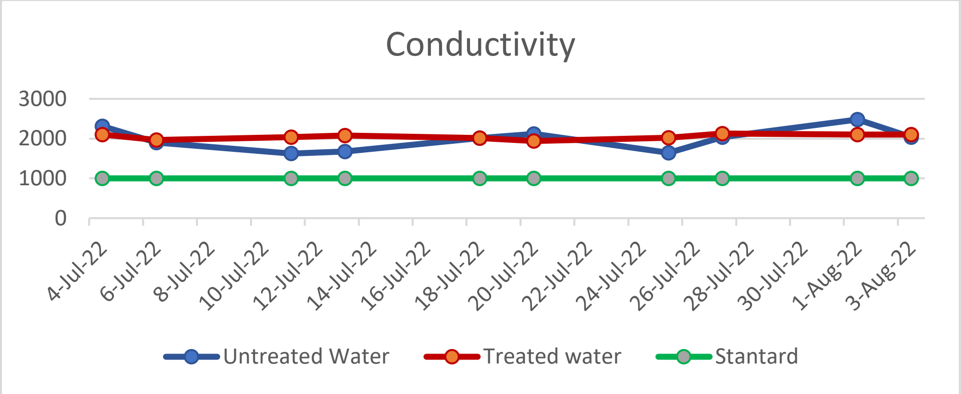

Figure 4: Conductivity variation

3.4 Variation in carbon pollution across basins

Variation in COD

The trends in Chemical Oxygen Demand (COD) levels in both raw and treated water across the various basins are presented. Measurements taken from the raw water entering the Kossodo WWTP reveal elevated COD concentrations, averaging 1110.1 ± 107.98 mg/L (Figure 5). This value is similar to the 45% reported for particulate COD by Konaté (2012) in raw wastewater from the same facility, indicating a predominance of dissolved COD forms, likely resulting from the pre-treatment processes applied to wastewater from the brewery, slaughterhouse, and other nearby industries. Overall, these parameters tend to decrease in value as they move through the basins.

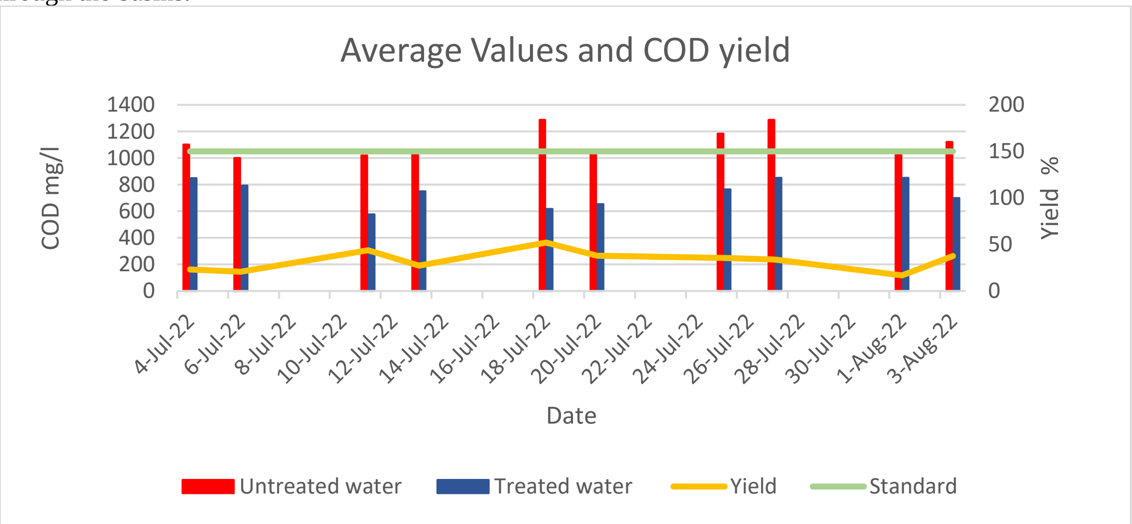

Figure 5: Variation in chemical oxygen demand (COD)

Variation of suspended solids

The analyses conducted on the Kossodo tributary, illustrated in Figure 6, indicate relatively high concentrations of Suspended Solids (SS), ranging from 502 mg/l to 373.5 mg/l, with an average of 453.8 ± 404 mg/l, as illustrated in Figure 6, which discusses the variation of Suspended Solids. These elevated SS concentrations can be attributed to the discharge of fecal sludge generated upstream into the lagoon system of the Kossodo Wastewater Treatment Plant (WWTP). The direct discharge observed at the raw water stage significantly heightened the concentrations of Total Suspended Solids (TSS) in the untreated water. Consequently, the variation in SS concentration in the ponds is practically strong, with average SS concentrations of 454.1 ±320 mg/l for the anaerobic ponds, 469±154 mg/l for the facultative pond, and 469.6 ±263 mg/l for the maturation basin.

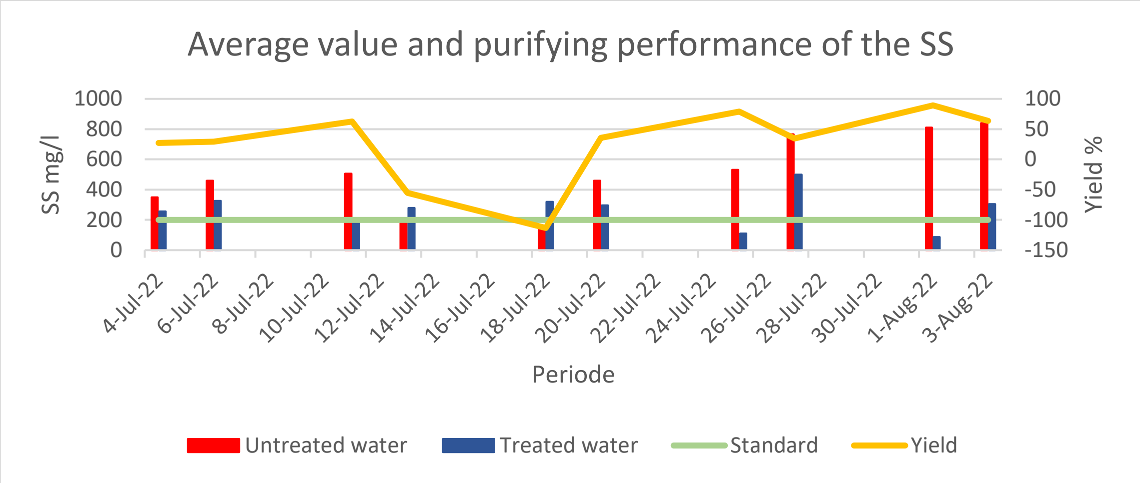

Figure 6: Evolution of the Suspended Solids (SS) concentration in the untreated water and the maturation basin

Variation in ammoniacal nitrogen and nitrate content

The evaluation of nutrient levels relied on the analysis of ammoniacal nitrogen, nitrates, and ortho-phosphates :

Measurements of raw wastewater from Kossodo reveal that ammoniacal nitrogen concentrations fluctuate between 1 and 25.3 mg/l, with an average of 9 mg/l. This indicates significant variability in the influent at the WWTP's entrance. The high concentrations of ammoniacal nitrogen (maximum value of 25.3 mg/l) are slightly higher than the values of 25 mg/l corresponding to raw domestic wastewater with a high concentration of ammoniacal nitrogen (Nascimento, 1991). Analyses of raw wastewater from the Kossodo Wastewater Treatment Plant (WWTP) indicate significantly elevated average nitrate levels of 50 mg/l, in contrast to the reported value of 0 mg/l for domestic wastewater by Nascimento (1991). Figure 7 illustrates the evolution of ammoniacal nitrogen in raw water and treated water. Table 3 shows the minimum, maximum, and average nitrate levels in the basins.

Table 3: maximum, minimum and average nitrate levels

	Untreated water	Treated water
Maximum (mg/l)	67	116
Minimum (mg/l)	33	30
Average (mg/l)	49.625	54.5

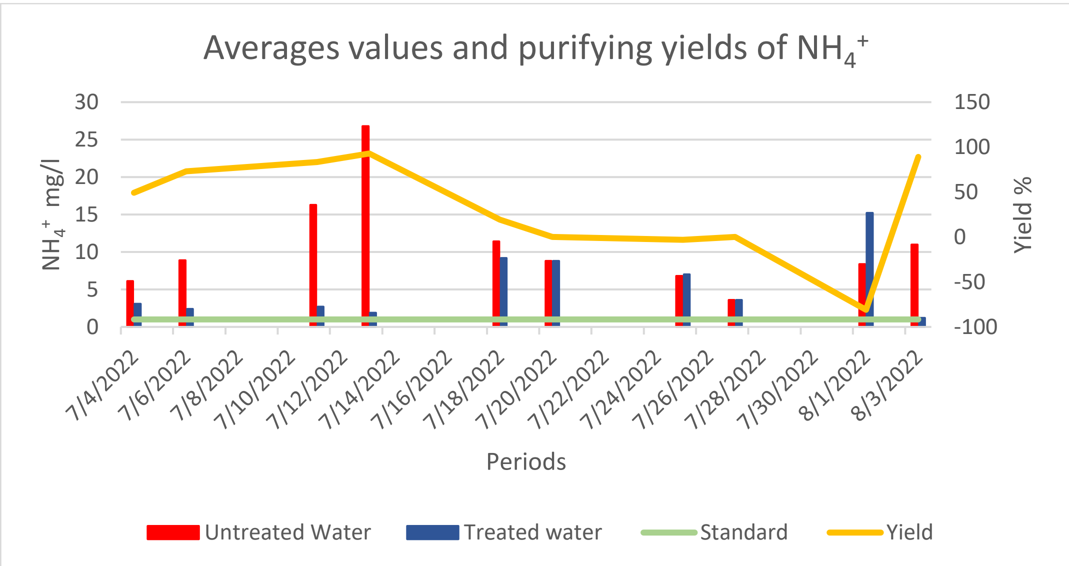

Figure 7: Variation of ammonia nitrogen in raw water and treated water

Variation of phosphorus

The evolution of ortho-phosphate contents at the levels of raw water and maturation basins. The average ortho-phosphate concentrations of 27 ± 11 mg/l increase in the maturation basin (31 ±8 mg/l) due to the phenomenon of phosphorus release often observed in anaerobic basins (Figure 8).

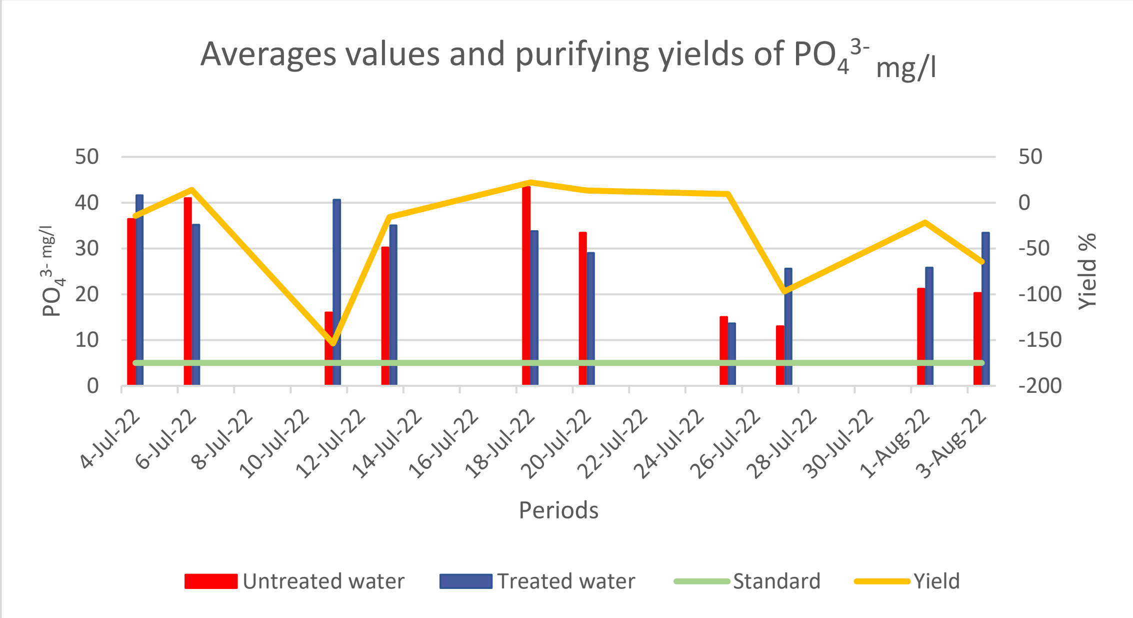

Figure 8: Variation of phosphorus

Variation in fecal contamination indicators in the ponds

Escherichia Coli (E. coli) enumeration

The figure 9 shows a decrease in *Escherichia Coli (E. coli)* concentrations from the entrance to the exit of the basins. Minimum values of $2x10^3$ and a maximum of $4.8x10^6$ CFU/100 ml are observed at the entrance to the Wastewater Treatment Plant (WWTP) with an average value of $7.7x10^5$ CFU/100 ml. Also, minimum values of $1.5x10^3$ and a maximum of $2.1x10^4$ CFU/100 ml are observed at the outlet of the Kossodo sewage basins with an average value of $6.9x10^3$ CFU/100 ml.

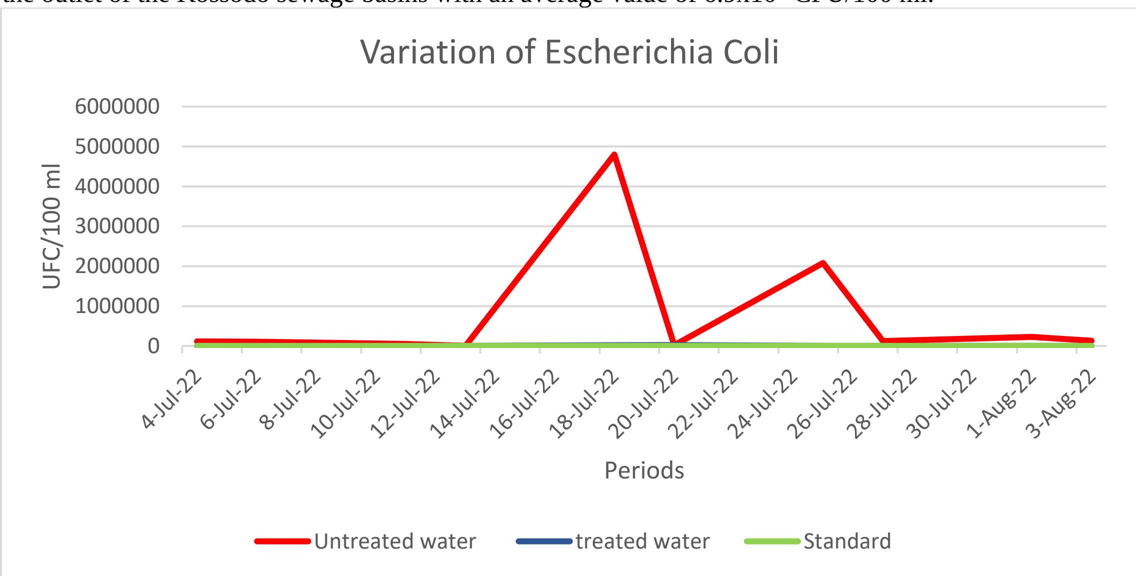

Figure 9: Variation of *Escherichia Coli*

Enumeration of fecal coliforms

Figure 10 indicates a decrease in the concentrations of fecal coliforms from the entrance to the exit of the ponds. Minimum values of $1.9x10^4$ and a maximum of $2.2x10^8$ CFU/100 ml are observed at the entrance to the WWTP with an average value of $6.5x10^7$ CFU/100 ml. Also, minimum values of $1.5x10^3$ and a maximum of $2.6x10^6$ CFU/100 ml are observed at the outlet of the Kossodo wastewater treatment basins with an average value of $3.4x10^5$ CFU/100 ml.

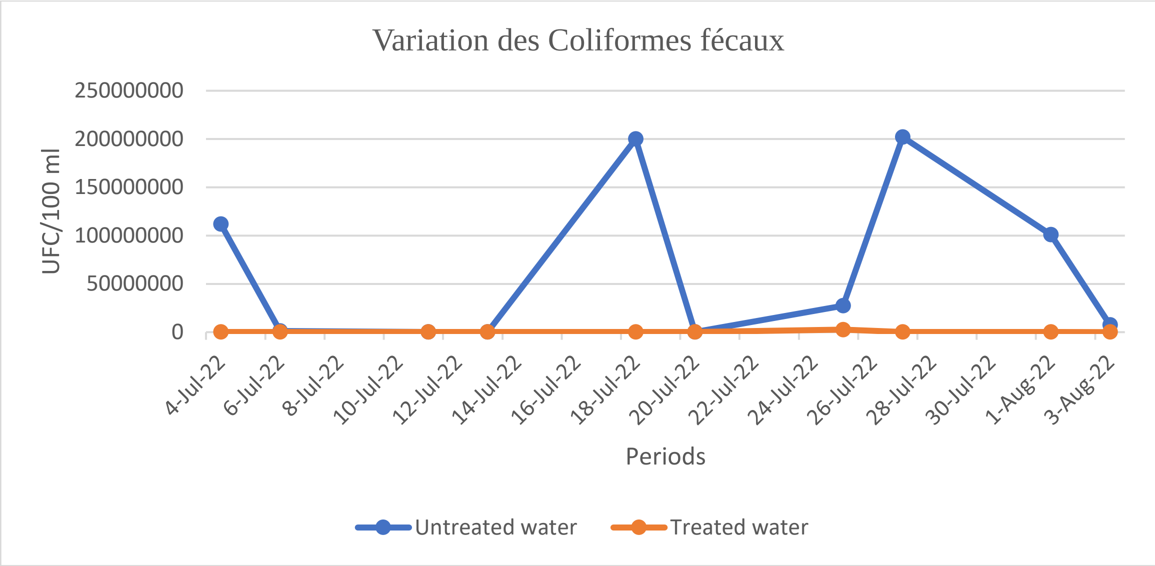

Figure 10: Variation of fecal coliforms

3.4 Evaluation of the operational efficiency of the Kossodo wastewater treatment facility.

Elimination of organic pollution

Elimination of chemical oxygen demand (COD)

Chemical Oxygen Demand (COD) allows for the assessment of the concentration of organic or mineral substances, whether dissolved or suspended in water, based on the amount of oxygen required for their complete chemical oxidation.

The average Chemical Oxygen Demand (COD) levels recorded for raw influents and treated effluents throughout the study period are 1054 mg of O_2/l and 795 mg of O_2/l, respectively. Demonstrating that purified water is still heavily loaded with organic nutrients and oxidizable minerals. Previous studies carried out by (Hamid et al., 2014) on the purification performance of the aerated lagooning system at the station in the city of Oujda in Morocco gave residual concentrations well above the values obtained from the lagooning station. The COD values obtained are well above the Burkinabe limit value which is 150 mg of O_2/L with an excess deviation of 158%.

Elimination of biological oxygen demand (BOD5)

Despite some failures observed in the oxytopes used in the laboratory, we obtained some results for samples analyzed in the first days of sampling. These results observed on raw and treated wastewater have an average overall elimination rate of 82%. Furthermore, previous studies carried out by (Cardot, 2001) revealed that without filtration, the reduction in BOD5 is low during the dry season due to the increase in the algal colony.

Elimination of suspended solids (SS)

The average suspended solids (SS) content of the treated effluents over the observation period is 266.72 mg/l. The relatively high average concentration of 266.72 mg/l observed in Kossodo treated water may be linked to the discharge of organic sludge. Releasing sludge at an uncontrolled rate can decrease the water's residence time in the basins, leading to an increase in the suspended solids concentration in the treated effluent (Kellouche & Abdelbaki, 2018). The average yield of 25.26% observed is largely higher than those obtained by (Zongo, 2013) after 9 years of operation of the same station. Considering the concentrations observed, the quality of the treated effluent from the Kossodo station does not meet the discharge standards of Burkina Faso (150 mg/l for the lagoon).

Nutrients Removal

Removal of total Kjeldahl nitrogen (NTK)

The average total Kjeldahl nitrogen (TKN) concentration in the treated effluents during the observation period is 704.48 mg/L. This residual level is significantly higher than the acceptable limit of 5 mg/L for total Kjeldahl nitrogen and exceeds the environmental discharge standards, which are set at 35 mg/L (Tinto, 2016). The overall assessment relating to the removal of total Kjeldahl nitrogen (NTK) resulted in an average removal performance of 24.14% for the Kossodo station. This average reduction rate in NTK is significantly lower than that found by (Tinto, 2016) which is 54.66%.

Elimination of ortho-phosphates

During this study, the phosphorous material is represented by orthophosphates. The overall evaluation relating to the elimination of phosphorous material resulted in an average performance of 26.99 mg/l. The treated effluent has an average orthophosphate content of around -30.82%. Based on the concentrations measured in the treated effluents, the quality of the wastewater at the outlet concerning ortho-phosphate does not comply with the national discharge standard of 5 mg/L.

Elimination of nutrients ($N\text{-}NH_4^+$, $N\text{-}NO_3^-$)

The nitrogen yields are 32.30% for ammoniacal nitrogen and under 70% for nitrates. The nitrogen removal yields are very low and lower than those reported by (Nascimento, 1991) on the lagoons of Portugal, in Portugal with a depth of 1.8 m and a residence time of 23 days.

Elimination of fecal contamination indicators

The influents of the Kossodo Wastewater Treatment Plant (WWTP) show fecal coliform loads ranging from a minimum of 1,9x10^4 to a maximum of 2,2x10^8 CFU/100 mL, with an average of 6,5x10^7 CFU/100 ml, as presented in Table 4, which discusses the parameters of fecal coliforms and Escherichia coli. This load differs significantly from that reported by Fagrouch (2010) in the Taourit Lagoon in Morocco. The residual fecal coliform content at the outlet averages 3,4x10^5 CFU/100 ml, exceeding the WHO standard of 1000 CFU/100 ml for non-restrictive irrigation reuse. Therefore, the results of our study indicate that the elimination of fecal coliforms is inadequate.

Table 4: Parameters of Fecal Coliforms and Escherichia Coli.

Parameters	Average entry	Average output	Yield in %	Abatement in ulog	Number of samples
Fecal Coliforms	6.5 10^7	3.4 10^5	55.41%	1.87	10
Escherichia Coli.	7.7 10^5	7 10^3	80.13%	1.53	10

The reduction in fecal coliforms is measured at 1.87 log units, while the reduction for Escherichia Coli (E. coli) is recorded at 1.53 log units. The bacteriological removal rates are consistent with the values reported by Maïga (2002) at The International Institute for Water and Environmental Engineering (2iE), which involved maturation basins with a depth of 0.9 m and a residence time of 5 days.

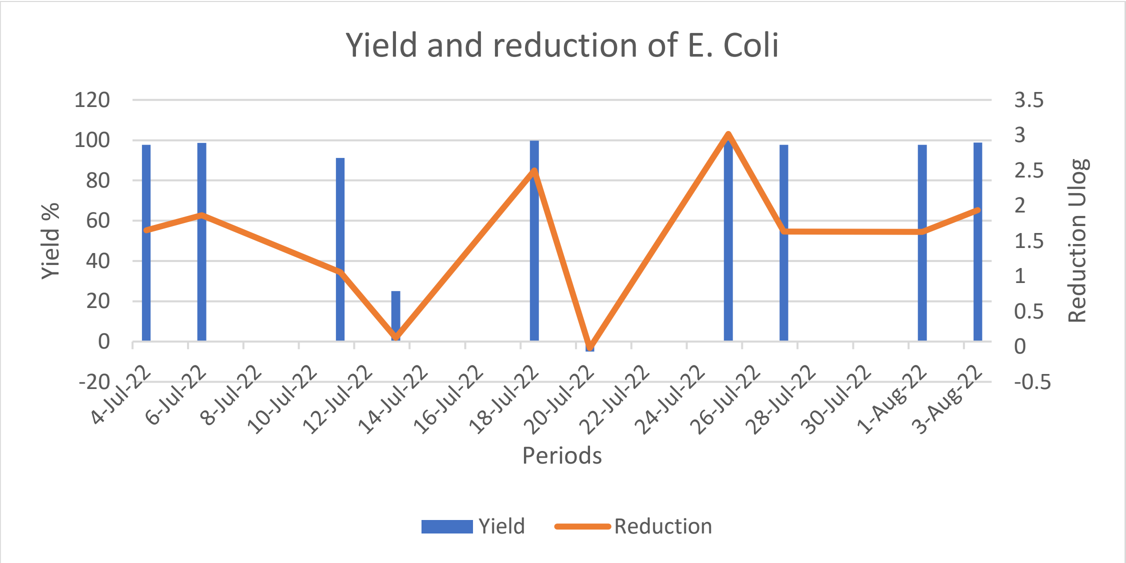

Figure 11: Yield and reduction of Escherichia Coli

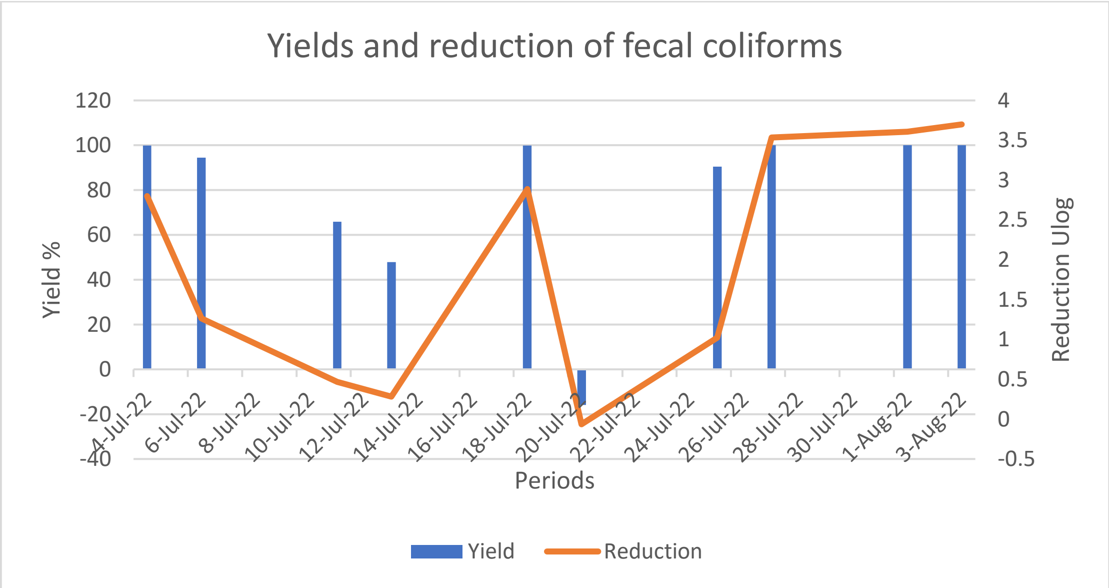

Figure 12: Yield and reduction of faecal coliforms

3.5 Discussion

The assessment of the treatment efficiency of the Kossodo Wastewater Treatment Plant (WWTP) has identified malfunctions that may impede its effective operation, as evidenced by the observed declines in the removal rates of specific parameters throughout the study. It is essential to propose potential solutions to address these issues. The decrease in the performance of the Kossodo WWTP could be due to the following factors:

3.5.1. Pink coloration of the facultative and maturation ponds:

Generally, the proper functioning of the lagoons ponds (facultative and maturation) is indicated by a greenish coloration due to the algal load of new formations. The pink coloration observed in the Kossodo lagoons is caused by the development of purple sulfur bacteria. This is detrimental to the development of algal populations, which are crucial for natural disinfection, particularly in the maturation ponds. According to a study by Karen (2021) on chlorophyll-a concentration, it was found that the Kossodo station has a low concentration of 12207 µg/l. This limits the availability of dissolved oxygen (produced during the photosynthetic activity of algae), a key parameter in maintaining aerobic conditions in the facultative and maturation ponds.

3.5.2. Reduction in retention time:

The disinfecting action of environmental parameters (temperature, pH, dissolved O_2, etc.) during lagoon treatment requires a substantial retention time. This retention time contributes to enhancing the quality of the effluents. The anticipated concentration of fecal coliforms in the treated wastewater, determined from the average load of raw wastewater and a theoretical retention time of 30 days, was calculated to be 2 CFU/100 ml. This value is significantly lower than the actual concentration measured, which is 34,105 CFU/100 ml. The wastewater reaching the WWTP does not remain there long enough before being discharged into the natural environment, which could be due, in the first instance, to the accumulation of sludge in the ponds, reducing their effective capacity. It is noteworthy that the station has been in operation for 16 years, and only one anaerobic pond out of the three was desludged in 2019 after 15 years of service.

3.5.3. Discharge of raw supernatant from sludge into a maturation pond:

It should be noted that during the study conducted at the Kossodo station, supernatants from sludge were directly discharged into one of the maturation ponds. Consequently, heavily clogged drying beds were found in the second maturation pond. This significantly reduces the treatment efforts of the previous ponds, without adhering to the required retention times in the ponds. This practice could explain the higher concentrations in the treated wastewater compared to the influent.
Thus, the direct and short-term solutions would be to recommend desludging the ponds to restore the normal retention time of the treatment chain and unclogging the drying beds to avoid the direct discharge of supernatants into the maturation pond.

4 CONCLUSION

The study conducted on the Kossodo wastewater treatment plant revealed several major malfunctions that compromise the efficiency of wastewater treatment. The analyses highlighted significant declines in purification performance, particularly due to the pink coloration of the ponds, caused by the development of purple sulfur bacteria, and the reduction in the retention time of wastewater in the ponds. These issues, combined with inappropriate practices such as the direct discharge of supernatants into the maturation ponds, have led to residual pollutant concentrations (suspended solids, ammoniacal nitrogen, fecal coliforms) that greatly exceed the standards in force in Burkina Faso. Physico-chemical measurements also showed large fluctuations in the pH values of the raw water, with maximum pH values reaching 10.57 which hinders the development of methanogenic bacteria essential in anaerobic ponds. Although the high temperatures (up to 34.1°C) reflect local climatic conditions, the high conductivity (2.480 µS/cm) indicates a significant degree of mineralization of the treated wastewater. The BOD5 reduction yields could not be properly evaluated due to technical failures, while the yields of raw COD (55%) and filtered COD (80.33%) are acceptable but far from optimal. It is evident that the quality of wastewater treatment at the Kossodo plant is unsatisfactory and does not meet the necessary environmental and health requirements. The residual concentrations of suspended solids (266.72 mg/l) and ammoniacal nitrogen (5.51 mg/l) exceed the Burkinabe standards for discharge into surface waters, set at 200 mg/l and 1.29 mg/l, respectively. Additionally, the residual concentrations of bacteria in the treated wastewater exceed the WHO standards for reuse in unrestricted irrigation. To address these deficiencies, ONEA must take urgent measures to restore adequate retention time in the ponds by desludging the ponds and unclogging the drying beds. Additionally, it is crucial to establish a periodic monitoring plan for chemical pollution (heavy metals) and fecal contamination parameters for each pond, to quickly detect problems and provide prompt solutions. These measures will not only enhance the purification performance of the plant but also mitigate the adverse effects on the environment and public health.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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