



Purifying Power of the Wastewater Treatment Plant in the City of Mechraa Belksiri (Gharb, Morocco)

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Abstract

The objective of our work is to evaluate the purification performance of the Mechraa Belksiri (Gharb, Morocco) Wastewater Treatment Plant (WWTP) of natural lagoon type, and situate the treated wastewater with Moroccan and European standards. Sampling was carried out monthly during the year 2022. The wastewater from the city of Mechraa Belksiri is loaded with organic matter (BOD5/COD = 0.44 and SS/BOD5 = 1.39) and has a satisfactory biodegradability (COD/BOD5 = 2.29). The station has an excellent purifying power with a very satisfactory reduction in BOD5 (83.14%), COD (82.24%) and SS (74.03%). Even if the treated wastewater complies with the Moroccan standards in force with an average of BOD5 (62.75 mg of O₂/l), COD (150.92 mg of O₂/l), and SS (133.25 mg/l), they don't with European standards. Hence, an improvement is expected in the station system.

Subject Areas

Environmental Sciences

Keywords

Wastewater, Performance, Abatement, Mechraa Belksiri, Morocco

1. Introduction

Morocco, like any country, needs drinking water as well as water intended for irrigation; moreover, in recent years, Morocco has experienced a drought favoring the reduction of these water resources. Morocco has established a policy of

considerable construction of wastewater treatment plants, which aims to reduce pollution in terms of domestic and industrial discharges, and contribute massively to the expansion of its strategic stock of drinking water or irrigation. This article is a continuation of a series of studies carried out in the city of Mechraa Belksiri and its region, aiming to make a complete study through the physico-chemical analysis of raw wastewater from the city of Mechraa Belksiri [1], the evaluation of its pollutant load [2], and by proposing an adequate solution for the treatment of wastewater from the city of Mechraa Belksiri [3] while respecting the directives of the standards for indirect discharge of wastewater in the receiving environment and used after treatment in the field of irrigation without forgetting the financial side of the project. The aim of this study is to evaluate the purification performance of the Mechraa Belksiri wastewater treatment plant (Gharb, Morocco), and classify it within the scale of Moroccan and European standards for discharge of treated wastewater into the external environment.

2. Environment

The town of Mechraa Belksiri is in the northwest of Morocco, at 34°34' North and 5°57' West, 47 km north of the town of Sidi Kacem and 80 km east of the town of Kenitra.

The Mechraa Belksiri region has an underground water resource, which is part of the Gharb aquifer [4]. The population of the town of Mechraa Belksiri is around 31,434 inhabitants [5]. The average daily consumption value of drinking water is around 3460 m³/d [6]. The town of Mechraa Belksiri has a separate type sanitation system. The network was created in the early 1980s [7].

The wastewater treatment plant in the town of Mechraa Belksiri is located in the east of the town (see **Figure 1**). The station is made up of 4 ponds for primary treatment which discharge the treated water into other ponds for secondary treatment. The treated wastewater is subsequently discharged into the river (Oued) Sebou (see **Figure 1**).



Figure 1. Geographical location of the Mechraa Belksiri WWTP.

3. Materials and Methods

3.1. Materials

The BOD₅ is determined by a BOD meter (OxiTop). The COD is determined by a spectrophotometer. Suspended Solids (SSs) are determined using a filter [8].

3.2. Methods

Wastewater sampling was carried out monthly, from January 2022 to December 2022 at the entrance and exit of the treatment plant. The wastewater samples were preserved according to the general guide to the conservation and handling of subsequent samples [9].

The BOD₅ analysis is determined by the breathing method using a BOD meter (OxiTop) at a temperature of 20°C. The COD is determined by a spectrophotometer. Suspended Solids (SSs) are determined by filtration of a volume of wastewater (100 ml) on a cellulose filter with a pore diameter of around 0.45 µm. The filter and its substrate are carefully dried in the oven at 105°C for 24 hours. The difference in mass before and after drying gives the suspended solids content, expressed in mg/l of wastewater [8].

4. Results and Discussion

4.1. Study of Wastewater at the Entrance to the Station

Monthly monitoring of wastewater at the entrance to the wastewater treatment plant in the town of Mechraa Belksiri (Gharb, Morocco) detected an annual average BOD₅ value of around 370 mg O₂/l with a minimum of 330 mg O₂/l and a maximum of 420 mg O₂/l (see **Figure 2**).

The annual average value of BOD₅ (370 mg O₂/l) of the wastewater treatment plant in the town of Mechraa Belksiri is higher than that recorded (184 mg O₂/l) at the entrance to the water treatment plant. treatment plant of Skhirat (Morocco) [10], and that recorded (368 mg of O₂/l) at the entrance to the treatment plant of Dar El Gueddari (Morocco) [11] as well as that of the main collector (162.08 mg of O₂/l) from Souk Elarbaa (Morocco) [12], but it is lower than that recorded (538.31 mg of O₂/l) at the entrance to the Nouakchott wastewater treatment plant (Mauritania) [13].

The annual average value of COD is of the order of 845.83 mg of O₂/l with a minimum of 750 mg of O₂/l and a maximum of 994 mg of O₂/l.

The annual average value of COD (845.83 mg of O₂/l) of the wastewater treatment plant of the town of Mechraa Belksiri is higher than that recorded (345.5 mg of O₂/l) at the entrance to the treatment plant. treatment plant of Skhirat (Morocco) [10], and that recorded (822.9 mg of O₂/l) at the entrance to the treatment plant of Dar El Gueddari (Morocco) [11] as well as that of the main collector (235.22 mg of O₂/l) from Souk Elarbaa (Morocco) [12], but it is lower than that recorded (1806.76 mg of O₂/l) at the entrance to the Nouakchott wastewater treatment plant (Mauritania) [13].

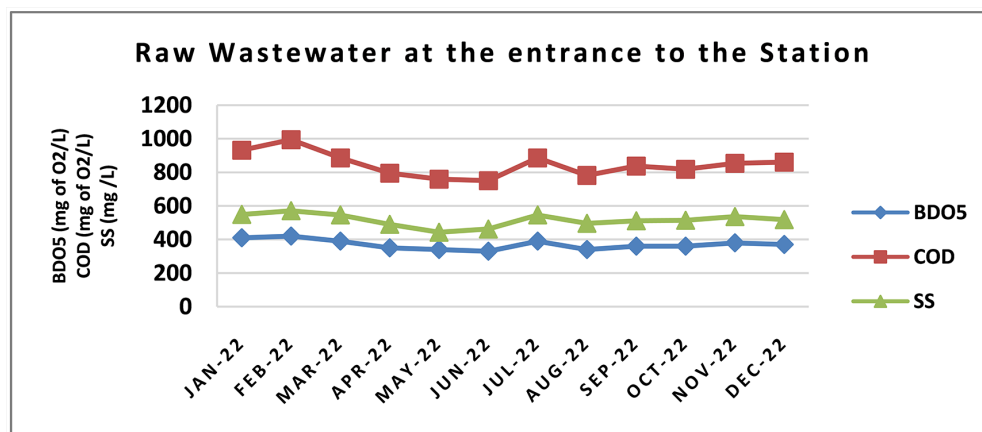


Figure 2. Gross monthly concentration of BOD5, COD and SS.

The annual average value of SS is around 515.17 mg/l with a minimum of 443 mg/l and a maximum of 571 mg/l.

The annual average value of SS (515.17 mg/l) of the wastewater treatment plant of the town of Mechraa Belksiri is higher than that recorded (342.5 mg/l) at the entrance to the wastewater treatment plant of Skhirat (Morocco) [10], and that recorded (325.2 mg/l) at the entrance to the Dar El Gueddari wastewater treatment plant (Morocco) [11] as well as that of the main collector (224.25 mg/l) of the Souk Elarbaa (Morocco) [12], but it is lower than that recorded (658.45 mg of O₂/l) at the entrance to the Nouakchott wastewater treatment plant (Mauritania) [13].

The correlation between COD and BOD5 is of the order of $R^2 = 0.96$, which is positively significant (Figure 3).

For a better assessment of the origin of wastewater, the calculation of the BOD5/DCO, COD/DBO5, and SS/DBO5 ratios is of very significant interest. The use of these parameters for characterizing wastewater therefore constitutes a good means of evaluating the degree of pollution of wastewater. The BOD5/DCO ratio gives very interesting indications on the origin of pollution and its treatment possibilities.

For our present study, the calculation of these ratios of wastewater from the city of Mechraa Belksiri (Gharb, Morocco) studied reveals average values grouped in Table 1.

The COD/BOD5 ratio makes it possible to deduce whether the wastewater has the characteristics of domestic wastewater (COD/BOD5 ratio less than 3). The results of this report constitute an indication of the importance of polluting materials with little or no biodegradability [14].

Wastewater from the town of Mechraa Belksiri has a BOD5/COD ratio which oscillates between 2.23 and 2.37 with an average of 2.29 (Table 1).

The COD/BOD5 ratio is 2.29 which is less than 3, therefore the wastewater of the city of Mechraa Belksiri is classified among the wastewater with medium organic load and easily degradable [14]. These results agree with those found by El Khokh *et al.* [2]. So, they are easily biodegradable.

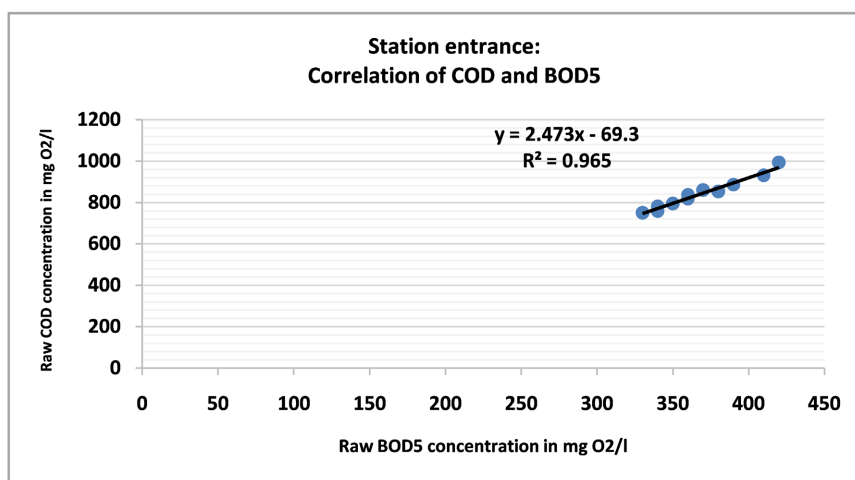


Figure 3. Correlation of COD and BOD5 at the station entrance.

Table 1. Average values of BOD5/COD, COD/BOD5 and SS/BOD5 ratios of raw wastewater.

	Raw wastewater at the entrance to the station		
	BOD5/COD	COD/BOD5	SS/BOD5
Average	0.44	2.29	1.39
Standard deviation	0.01	0.04	0.04
Minimum	0.42	2.23	1.30
Maximum	0.45	2.37	1.46
Number of samples	12	12	12

Wastewater from the town of Mechraa Belksiri has a BOD5/COD ratio which oscillates between 0.42 and 0.45 with an average of 0.44 (**Table 1**).

The BOD5/COD ratio of the city of Mechraa Belksiri has an average of 0.44, therefore, the wastewater of the city of Mechraa Belksiri is domestic in nature and loaded with organic matter which requires biological treatment.

Wastewater from the town of Mechraa Belksiri has a SS/BOD5 ratio varying from 1.46 to 1.30 with an average of 1.39 (**Table 2**). The low value of SS is explained by the existence of a separative type sanitation system in the town of Mechraa Belksiri.

The results of the BOD5/DCO, COD/DBO5, and SS/DBO5 reports confirm that the wastewater from the town of Mechraa Belksiri is loaded with organic matter and is easily biodegradable [14].

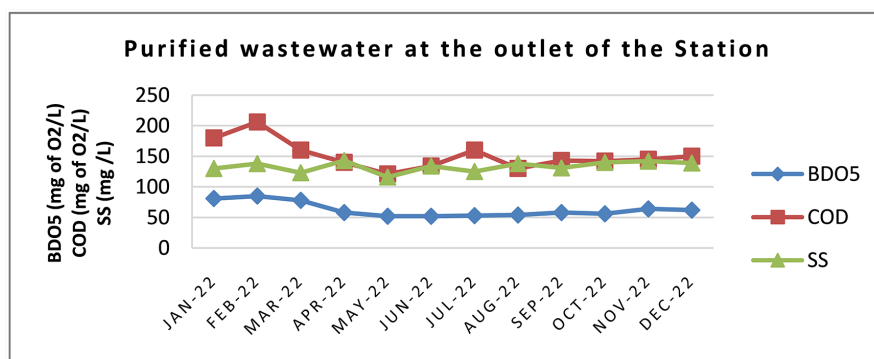
4.2. Study of Wastewater at the Station Outlet

Monitoring the discharge of wastewater from Mechraa Belksiri (Gharb, Morocco) at the outlet of the station made it possible to detect the following results (see **Figure 4**).

The annual average BOD5 value is around 62.75 mg O₂/l with a minimum of 52 mg O₂/l and a maximum of 85 mg O₂/l.

Table 2. Rate of reduction of BOD5, COD and SS.

	Raw average	Purified average	Reduction in %
BOD5 (mg d'O ₂ /l)	370.00	62.75	83.14
COD (mg d'O ₂ /l)	845.83	150.92	82.24
SS (mg/l)	515.17	133.25	74.03

**Figure 4.** Purified monthly concentration of BOD5, COD and SS.

The annual average value of BOD5 (62.75 mg of O₂/l) at the outlet of the wastewater treatment plant of the city of Mechraa Belksiri is higher than that recorded (16.67 mg of O₂/l) at the outlet of the station treatment plant of Skhirat (Morocco) [10], and that recorded (121 mg of O₂/l) at the outlet of the treatment plant of Dar El Gueddari (Morocco) [11].

The annual average value of COD is of the order of 150.92 mg of O₂/l, with a minimum of 121 mg of O₂/l, and a maximum of 206 mg of O₂/l.

The annual average value of COD (150.92 mg of O₂/l) at the outlet of the wastewater treatment plant of the city of Mechraa Belksiri is higher than that recorded (56.86 mg of O₂/l) at the outlet of the Skhirat wastewater treatment plant (Morocco) [10], and that recorded (328.02 mg of O₂/l) at the outlet of the Dar El Gueddari wastewater treatment plant (Morocco) [11].

The annual average value of SS is around 133.25 mg/l, with a minimum of 115 mg/l and a maximum of 143 mg/l.

The annual average value of SS (133.25 mg/l) at the outlet of the wastewater treatment plant of the town of Mechraa Belksiri is higher than that recorded (108 mg/l) at the outlet of the wastewater treatment plant of Skhirat (Morocco) [10], and that recorded (92.2 mg/l) at the outlet of the Dar El Gueddari wastewater treatment plant (Morocco) [11].

The correlation between COD and BOD5 is of the order of $R^2 = 0.75$. So, it is positively significant (Figure 5).

4.3. Evaluation of the Station's Cleaning Performance

According to the results illustrated in Table 2, we have:

The percentage of BOD5 reduction (83.14%) is lower than that of the Skhirat

station (Morocco) (88.35%) [10], but it is higher than that of the Dar El Gueddari station (Morocco) (67.11%) [11].

The COD abatement percentage (82.24%) is lower than that of the Skhirat station (Morocco) (87.26%) [10], but it is higher than that of the Dar El Gueddari station (Morocco) (60.1%) [11].

The reduction percentage of SS (74.03%) is higher than that of the Skhirat station (Morocco) (68.37%) [10], and that of the Dar El Gueddari station (Morocco) (71.64%) [11] infers that the reduction of the station is effective.

4.4. Comparison with Moroccan Standards

According to Official Bulletin number 5448 of 08/17/2006, the BOD5 values at the outlet of the station are of the order of 62.75 mg of O₂/l, which are lower than those required by the Moroccan law which is of the order of 120 mg of O₂/l, hence, they are within the Moroccan standards.

The COD values at the outlet of the station are of the order of 150.92 mg of O₂/l, which are lower than 250 mg of O₂/l required by the Moroccan standards, therefore they are within the Moroccan standards.

Likewise for SS, which is equal to 133.25 mg/l, which is less than 150 mg/l described by the laws of Moroccan standards, therefore it is also within the standards.

4.5. Comparison with European Standards

The values of BOD5 (62.75 mg of O₂/l), COD (150.92 mg of O₂/l), and SS (133.25 mg/l) at the outlet of the station are all higher than those required by the European standards which are respectively BOD5 (25 mg of O₂/l), COD (125 mg of O₂/l), and SS (35 mg/l).

Wastewater from the Mechraa Belksiri treatment plant will under no circumstances be reused in agriculture or for watering green spaces.

To reuse this treated wastewater to be reused, it must undergo tertiary treatment

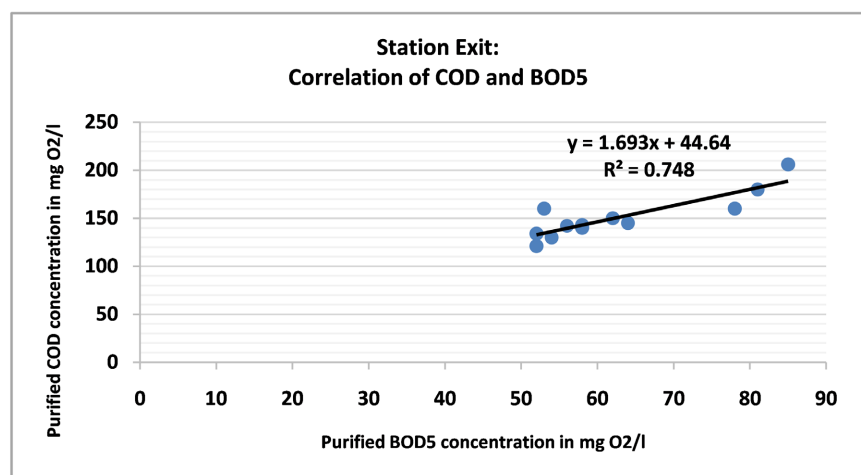


Figure 5. Correlation of COD and BOD5 at the station outlet.

through plant system improvement.

5. Conclusions

The town of Mechraa Belksiri (Gharb, Morocco) has a natural lagoon-type wastewater treatment plant.

The study of the overall parameters of wastewater at the entrance to the station was able to reveal that the annual average values of BOD5 are 370 mg of O₂/l, those of COD are 845.83 mg of O₂/l, and those of SS are 515.17 mg/l.

The wastewater at the entrance to the station is loaded with organic matter with a ratio of BOD5/COD = 0.44 and a ratio of SS/BOD5 = 1.39, and presents satisfactory biodegradability with a ratio of COD/BOD5 = 2.29.

The study of the overall parameters of wastewater at the outlet of the station was able to reveal that the annual average values of BOD5 are 62.75 mg of O₂/l, those of COD are 150.92 mg of O₂/l, and those of SS are 133.25 mg/l.

The values of the overall parameters of the wastewater at the outlet of the station compared to those found at the entrance to the station reveal that the Mechraa Belksiri treatment plant (Gharb, Morocco) has excellent purifying power with a reduction in BOD5 = 83.14%, that of COD = 82.24%, and that of SS = 74.03%.

The annual average values of BOD5 (62.75 mg of O₂/l), those of COD (150.92 mg of O₂/l), and those of SS (133.25 mg/l), found at the outlet of the Mechraa Belksiri wastewater treatment plant (Gharb, Morocco), are all lower respectively than those required by the Moroccan standards BOD5 (120 mg of O₂/l), COD (250 mg of O₂/l), and SS (150 mg/l). Hence, the station meets Moroccan standards.

These same annual average values of BOD5 (62.75 mg of O₂/l), those of COD (150.92 mg of O₂/l), and those of SS (133.25 mg/l), found at the outlet of the Mechraa Belksiri wastewater treatment plant (Gharb, Morocco), are all superior respectively to those required by the European standards BOD5 (25 mg of O₂/l), COD (125 mg of O₂/l), and SS (35 mg/l). Hence, the station does not meet European standards.

It is concluded that treated wastewater cannot under any circumstances be reused in agriculture or green spaces.

6. Perspectives

Even if the Mechraa Belksiri wastewater treatment plant (Gharb, Morocco) has an excellent purification power with a reduction in BOD5 = 83.14%, that of COD = 82.24%, and that of SS = 74.03%, it does not meet European standards; and subsequently, the treated wastewater cannot under any circumstances be reused in agriculture or green spaces. For this, it requires another tertiary treatment, which may be a subject of interest in the future.

Conflicts of Interest

The authors declare no conflicts of interest.

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