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Evaluation of the treatment of purified wastewater in the city of Bouira (Algeria)

Naziha Lamri[1]*, Nassima Bachouche[2], Leila Bentaleb[3]

[1 2 3] Laboratory for the Management and Valorisation of Natural Resources and Quality Assurance, Akli Mohand Oulhadj University of Bouira, Algeria

* n.lamri@univ-bouira.dz

Abstract. Wastewater reuse is a popular practice in some regions of the world, affected by water shortages. After purification techniques, wastewater can be used in several areas of irrigation and industry. Only, there are international standards declared by the World Health Organization for these waters discharged from the sewage plant. In this research, we tried to evaluate these purified wastewaters by choosing the wastewater treatment plant of Bouira. We took samples of raw water and purified water to perform common physico-chemical analyses such as (pH, turbidity, temperature, BOD_5, conductivity), whose purpose is to control the quality of water before and after treatment. This control operation lasted one month (February and March) of the year 2022. The results of the physico-chemical parameters of raw wastewater and treated wastewater are analyzed and compared with the thresholds set by the wastewater treatment plant of Bouira. At the end, we have shown that the treated water does not practically meet the standards of discharge, because the values of the physico-chemical parameters and the parameters of pollution exceed the standards, which does not encourage their reuse.

Keywords. Wastewater, Physico-chemical parameters, Sludge index, Conductivity.

1. Introduction

Wastewater is an extremely complex medium that changes with artificial activity due to domestic, industrial, artisanal, agricultural or other uses. It is considered contaminated and must therefore be purified in any reuse or injection into the natural receiving environment.

According to Rejsek (2002) [1], wastewater is water containing contaminants, soluble or insoluble, mainly from human activities. Wastewater is usually mixed with contaminants corresponding to these categories, dispersed or dissolved in water already used for domestic or industrial purposes.

In fact, a water is considered as " wastewater " when its state, its composition, is modified by anthropic actions to such an extent that it lends itself less easily to all or some of the uses to which it can be put in its natural state [2]

The water thus collected in the sewer system is presented as a cloudy liquid, usually gray, with suspended solids of mineral and organic origin are at very different levels. In addition to rainwater, urban wastewater mainly domestic, may contain extremely diverse residual water of industrial origin [3].

Indeed, the treatment can be centralized in a treatment plant or it is also possible to go through intensive or extensive processes alone [4]. Therefore, municipal wastewater contains the following components: residual water or wastewater from domestic and industrial and/or agricultural production and storm water or urban runoff [5].

Wastewater reuse is a popular practice in some regions of the world affected by water shortages [6]. The Mediterranean basin is one of the regions of the world where urban effluent reuse is practiced [7]. For example, Tunisia has a national policy of valorization of this category of water [8]. In Algeria, this field is not very developed, and the system is not in place to allow the realization of the expected perspectives to face the problems emanating from wastewater. Indeed, only 20% of the wastewater collected in Algeria is treated, against a coverage of the sewerage network of about 85% [9].

In this work, we took a model of a wastewater treatment plant located in the city of Bouira, it is set up 2013, in order to carry out treatment operations of wastewater from the sewerage network of the city of Bouira. This city was chosen for its agricultural vocations, so it is appropriate that these purified waters are used for the irrigation of its hectares of agricultural land, especially for the use of industrial facilities.

2. Theory and methodology

2.1 Research methodology

Our research exposes the different stages of wastewater treatment from its arrival at the treatment plant to the obtaining of purified water through different devices: screen, distributor, thickener...etc. As, we will try to evaluate the physical and chemical quality of these purified wastewater. To achieve this objective, we worked at the level of the wastewater treatment plant of Bouira (SETP Bouira). Raw and treated water samples were taken for routine physic-chemical analysis. These are mainly PH, turbidity, temperature, BOD_5, conductivity...etc. In order to control the water quality before and after treatment, this operation lasted one month (February and March) of the year 2022.

The results of the physical-chemical parameters of the raw wastewater and treated wastewater are analyzed and compared with the set thresholds of the wastewater treatment plant of Bouira (SETP Bouira), and also interpreted in relation to the standards recommended by the World Health Organization, in order to evaluate the purification efficiency of the sludge at the level of the Bouira wastewater treatment plant.

2.2 Description of the study area (city of Bouira and STEP Bouira)

Bouira is the capital of the province of Bouira, it is located about 110 km southeast of Algiers and south of the Djurdjura mountain range in the Tellian Atlas. It is located on the plateau overlooking both banks of Oued Eddhous at an altitude of 550 m [10]

The municipality covers an area of 9524 ha and has an estimated population of 83388 inhabitants (RGPH 2008), however, it has reached 114135 inhabitants in 2020 [11]. The municipality of Bouira is limited to the north by the municipality of Ait Laaziz; to the east by the municipalities of Haizer and Taghzout; to the south by the municipalities of El Asnal and Oued El Berdi, and to the west by the municipalities of Ain Turk and Ain El Hadjar (Fig.01).

The municipality of Bouira is essentially composed of individual dwellings and collective housing, most of which have been built in recent decades. The housing stock registered in the municipality has increased from 9705 dwellings in 1998 to 35975 dwellings in 2020 [11]. This means that the use of water is also increasing. The city of Bouira has a geostrategic situation [12], makes it a center of political, economic and cultural influence, it has become a crossroads or cross and develop all activities.

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The municipality of Bouira has a rich and varied territory where practically all agricultural crops (forage, arboriculture, market gardening) are mixed [13]. Indeed, according to the statistics of the Directorate of Agriculture of the province of Bouira, an area extends over 190 ha planted with olive trees, and 38 ha of fig trees, 73 ha of pitted stones, 627 ha of market gardening crops and 5350 ha produced cereals [10].

The climate of the region of Bouira is of the temperate Mediterranean type, hot and dry in summer, rainy and humid in winter [14]. According to statistics raised from the site (meteoblue) of the period 1985-2015 the average annual temperature of the city of Bouira is 18.5 ° C, The rainy period ranging from November to April. On the other hand, the rainfall shows an irregular monthly and annual rainfall rhythm from one year to another.

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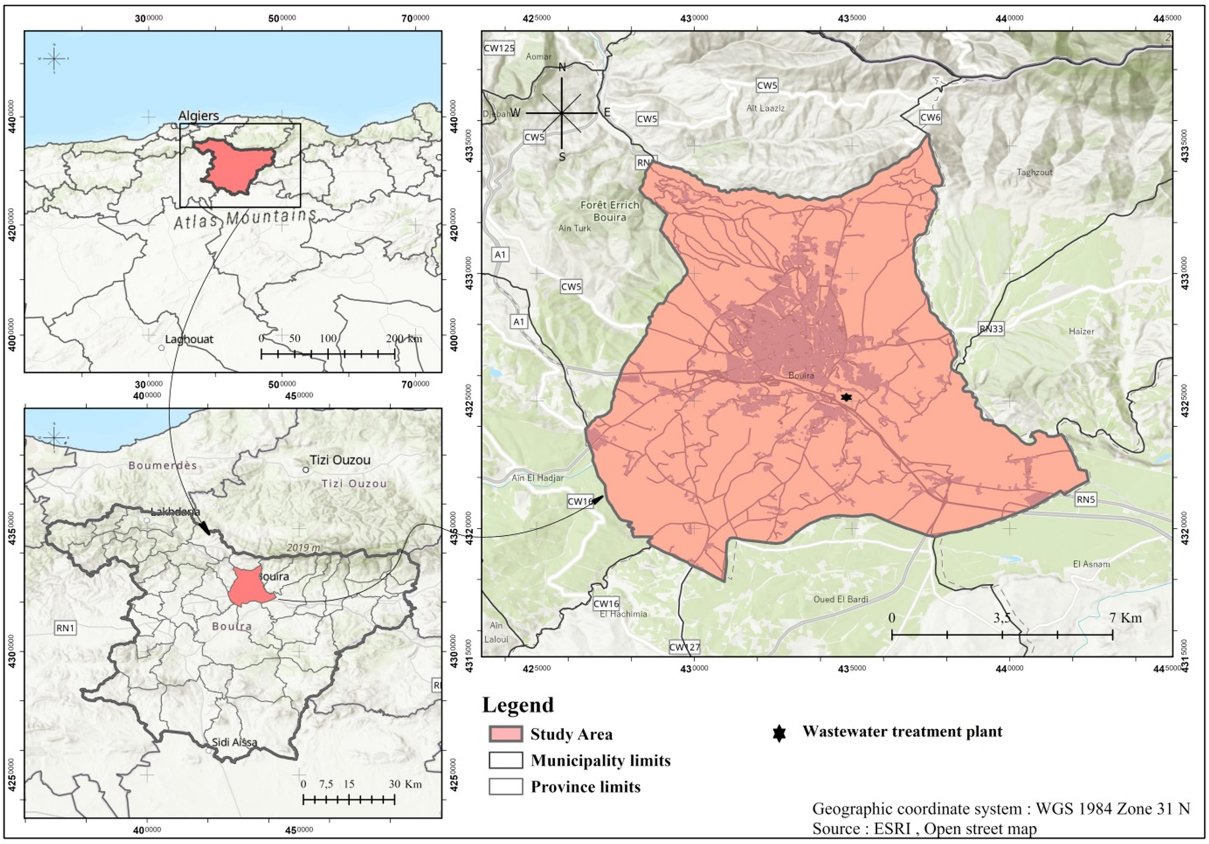

Fig 1. Location of Bouira city

The wastewater treatment plant (STEP) is located east-south of the chief town of Bouira. It is a subsidiary of the ONA (National Sanitation Office), this station is made by a German company "PASSAVANT RODIGER" [15]. The operation was entrusted to the ONA on 01/06/2013, on a total area of 10 Ha. This wastewater treatment plant has a nominal capacity of 129,000 population equivalent and treats carbon, nitrogen and phosphorus pollution. The wastewater to be treated by the treatment plant is made up of domestic and rainwater effluents (Fig.2).

The domestic population has been estimated at 80% of the load treated by the plant, the industrial wastewater will therefore represent 20% of the total load.

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Fig 2. Localisation de la station d'épuration des eaux usées de la ville de Bouira (google earth)

The main objective of a wastewater treatment plant is [16]: To protect public health; to preserve the environment against pollution; to treat wastewater from the city of Bouira; to reuse the treated water in the irrigation of agricultural lands of the plateaus of El Esnam and Sahel which are in the region of the province of Bouira; To allow the improvement of the quality of drinking water for the benefit of the inhabitants of the city of Bouira; To provide a treatment of ammonium (No_4), nitrate (No_3) and suspended solids (TSS) and phosphorus and organic load [17].

2.3 Description of the purification process

The raw wastewater arrives at the lifting station by gravity, where it is pushed to the entrance of the Bouira station. At the entrance of the latter, the parameters of pH, conductivity and temperature are measured by special sensors. The water is first passed through a manually cleaned coarse screen to remove coarse impurities (>50 mm), then through an automatic fine screen to remove fine impurities (>8 mm).

After that, the water arrives in the two desanding/deoiling lines, where the sand is eliminated by simple decantation and the oils by flotation by injecting air under pressure through the two air suppressors. The water then passes through the distributor, which makes it the same as return sludge (contact area) is mixed to form activated sludge and goes to the biological tanks [16]. After the biodegradation of carbon, nitrogen and phosphorus pollution in the biological basins, the water enters the two clarifiers where the purified water/sludge is separated by simple settling.

The purified water evacuated from the clarifier blades to the sanitation baffle (disinfection) and then towards the receiving environment (Oued Hous). A part of the sludge from the clarifier is conducted to the biological basins, by mixing with the raw water at the level of the distributor (contact zone) and another part is pumped in the thickness which will be thickened and then moved to the bottom (aerobic stabilizers).

Finally, turned to mechanical dewatering, involving the use of two belt presses and the addition of cationic polymers to mechanically dewater the sludge [18]. The sludge can also be dried naturally on the drying bed. Finally, the mechanically or naturally dehydrated sludge (dried layer) will be sent to a technical landfill (CET).

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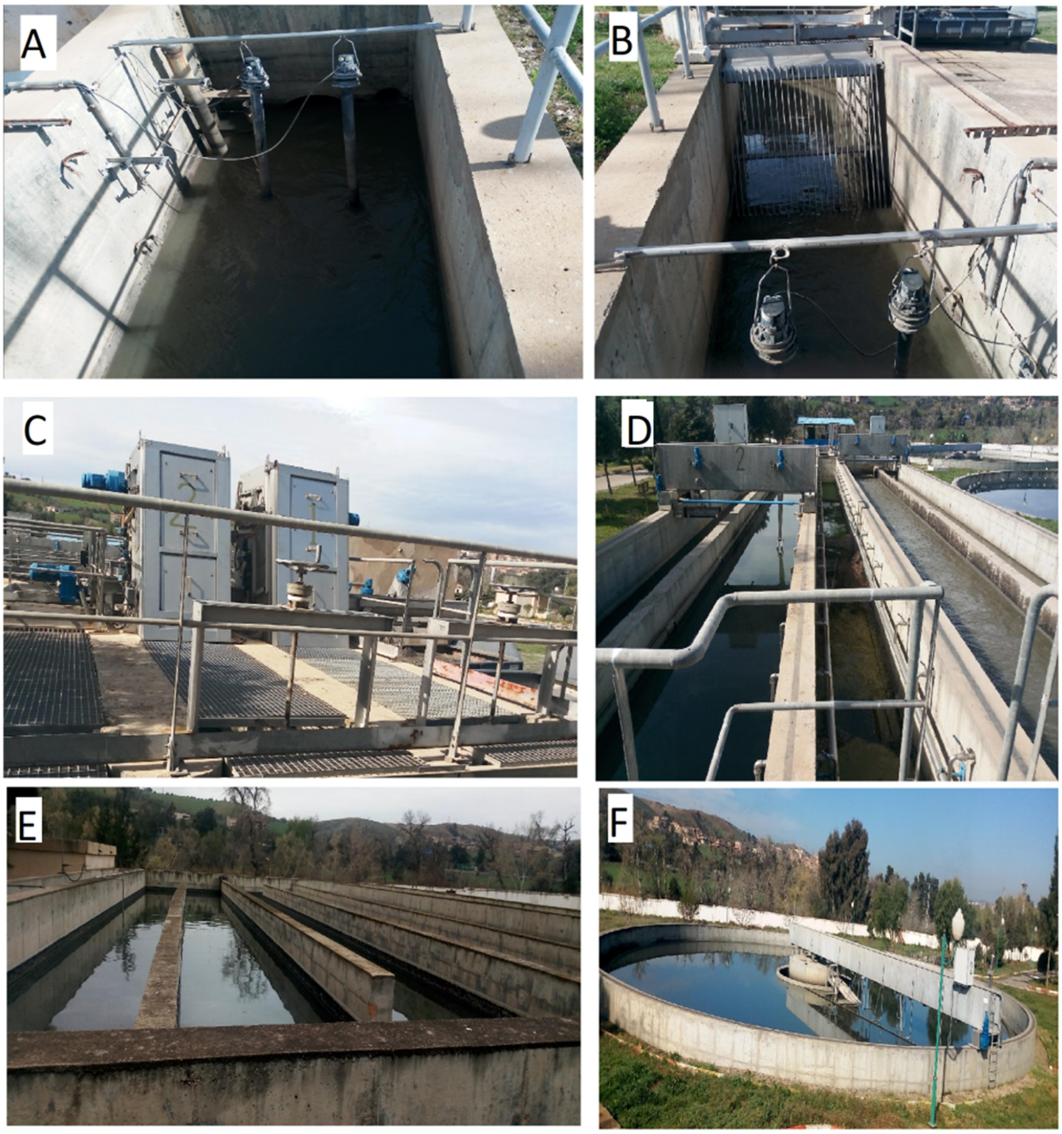

Fig 3. Different stages of the purification process at STEP Bouira (original photo)
(A) Inlet chamber; (B) Coarse screen; (C) Fine screen; (D) Sand/oil removal; (E) Splitter; (F) Clarifier

3. MATERIELS ET METHODES

In this section, the operating protocols, techniques, and methods of measurement and analysis to be followed for the treatment of wastewater before and after discharge into the receiving environment are described.

3.1 Water branch

For the samples intended for the physical-chemical analysis of water, they are carried out in plastic bottles; one uses a pole of 2 to 3m (fig.04). All the analyses were carried out at the laboratory of the STEP.

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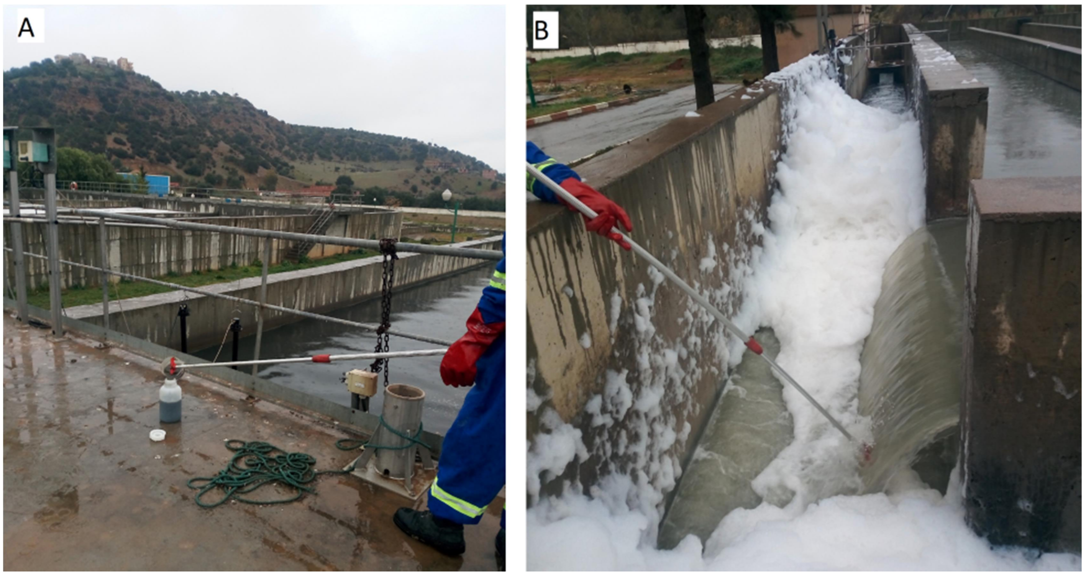

Fig 4. Sampling at entry (A) and exit (B)

3.1.1. Physical-chemical analysis.

a- The hydrogen potential (PH)

Its aim is to determine the acidity, neutrality, or alkalinity of water. The method is based on the use of a PH meter [19]. It is a somewhat unusual voltmeter that is characterized by very high input impedance due to the high resistance presented by the measurement electrode [20]. It is used the PH meter (fig.05) and accessories; Magnetic stirrer; Beakers; Raw water and purified water.

b- Temperature (T°)

Knowing the water temperature accurately is very important. Indeed, it plays a role in the solubility of salts, especially gases, on the dissociation of dissolved salts and thus on the electrical conductivity [21]. Temperature should be measured by a conductivity or pH meter where these usually have a built-in thermometer.

c- The Conductivity

The electrical conductivity of water is the conductance of the water column between two metal electrodes with a surface area of 1cm2 and separated by 1 cm from each other [22]. It is the inverse of the electrical resistivity. The conductivity is the siemens per meter (S /m).

d- **The Turbidity**

Turbidity is the reduction in transparency of a liquid due to the presence of undissolved fine materials such as (clay, silt, silica particles, organic matter...etc) [23].
The spectrophotometer (Fig.05) is used to check the turbidity of water and COD, DBO_5 (spectrophotometer method) [16].

3.1.2. Chemical parameters.

BOD_5 is measured after 5 days at 20 C° (temperature favorable to the activity of oxygen consuming microorganisms) and in the dark (to avoid any photosynthesis, parasite) [24].
- Two samples are needed: the first one is used to measure the initial O_2 concentration, and the second one at the end to measure the residual O_2 concentration after 5 days.
- BOD_5 is the difference between the two concentrations.

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The measurements will be made on the same volume and the second sample will be kept for 5 days in the dark at 20°C.
- Indeed, water left to itself in a closed bottle will quickly consume the dissolved oxygen. We use Oximeter; Aerator; Magnetic stirrer; Bottles.
- During 05 days the sample is stirred continuously. The oxytope (Fig.05) automatically records a value every 24 hours during 05 days.
- Convert the displayed values (digits) into BOD_5 values with the following table:
(Digits* factor = BOD_5 in mg/l).

Table 1. BOD_5 factors and ranges

Sample volume (ml)	Measuring range (mg/l)	Factor
432	0--------------40	1
365	0--------------80	2
250	0-------------200	5
164	0-------------400	10
97	0-------------800	20
43.5	0-----------2000	50
22.7	0-----------4000	100

Fig 5. PH meter (A); Conductivity meter (B); Spectrophotometer (C); Incubator (D)

3.2 Sludge branch

The sludge of the sewage treatment plant designates all the residues of the biological activity of the micro-organisms living in the sewage treatment plants, which transform the materials transported by the wastewater so that they can be extracted from it. They are constructed essentially of water, mineral salts, and organic matter [25]. In this experiment, we will begin the procedure for the determination of the amount of DM, VSS, TSS, SI, efficiency, and V_{30}.

3.2.1. The V30.

- Homogenise the effluent to be analyzed.
- Pour 1 liter into a test tube (the test tube), and let it decant for 30 minutes.
- This process is repeated 3 times.

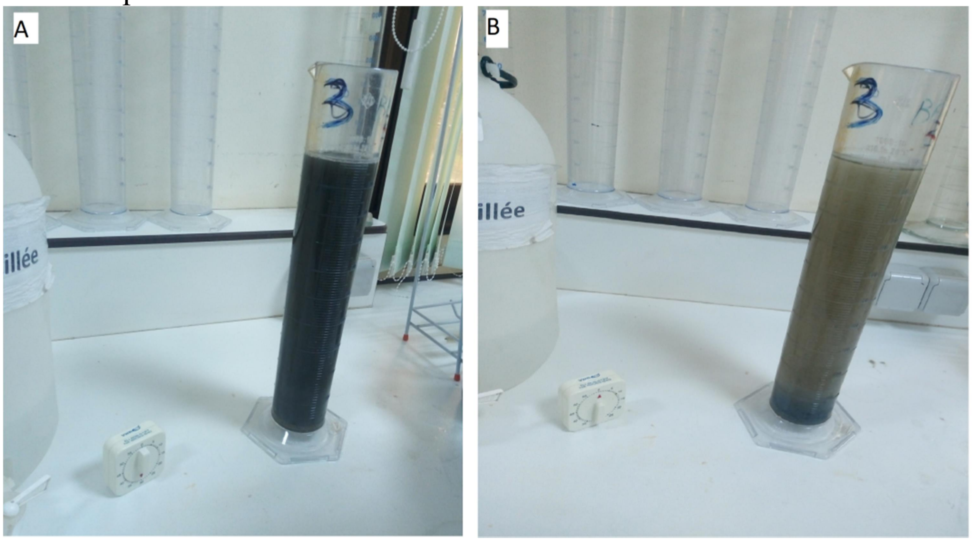

Fig 6. V30 before decantation (A), decantation after 30min (B)

3.2.2 DM, VSS.

Dry matter (DM) is the substance obtained when water is removed from a liquid after drying at 105°C, the percentage of dry matter is the relationship between the weight of dry matter and the mass of non-dry matter.

Volatile suspended solids (VSS) is an organic fraction of suspended solids obtainable by the mass difference between a sample of suspended solids (TSS) and the residue obtained following a 525°C oven run (Jury, 2021).

a- **Determination of DM and VSS by filtration methods**

- Dry the filters (glass fiber) to constant point in an oven at 105°C and weigh the filters (P_0).

-Filter through a vacuum pump a volume V (100 ml) of each sample.

-Then dry in the oven at 105°C for 2h (Fig.07).

-Weigh the filters (P_1) using the balance (Fig.07)

$$\mathbf{TSS = (P_1 - P_0) * 1000 / V}$$

(TSS: Suspended solids; P0: Weight of empty filter; P1: Weight of filter + weight of dewatered sludge; V: Sample volume)(Wang et al., 2021)

-Put the filters in the oven (Fig.07) for 2h at 525°c ± 5°c.

-Let cool in a freezer (Fig.07) and weigh the filters (P2)

$$\mathbf{(VSS) = (P_1 - P_2) * 1000 / V.}$$

(VSS: Volatile suspended solids; P1: Filter weight + dewatered sludge weight; P2: Filter weight + dewatered sludge weight after oven drying at 525°C for 2h; V: Sample volume)(Arenas et al., 2021)

b- Determination of DM and VSS by centrifugation method

- Take a volume of sample V and introduce it into the centrifuge for 20min at 3000rpm.
- Collect the centrifuged pellet in a porcelain capsule previously dried at 105°c and weighed (P_0).
- Rinse the centrifuge cup) twice with about 20ml of distilled water and then collect the rinse water in the capsule (Fig.07.
- Dry the capsules in the oven at 105°c until a constant point (2h).
- Allow to cool in the desiccator and weigh the capsule (P1).

$$\mathbf{(TSS) = (P_1-P_0)*1000/V}$$

(VSS: Volatile suspended solids; P1: Filter weight + dewatered sludge weight; P2: Filter weight + dewatered sludge weight after oven drying at 525°C for 2h; V: Sample volume)(Arenas et al., 2021)

- Place the capsules in the oven for 2 hours at 525°c±5°c.
- Let cool in a desiccator and weigh the capsule (P2).

$$\mathbf{VSS = (P_1- P_2)*1000/V}$$

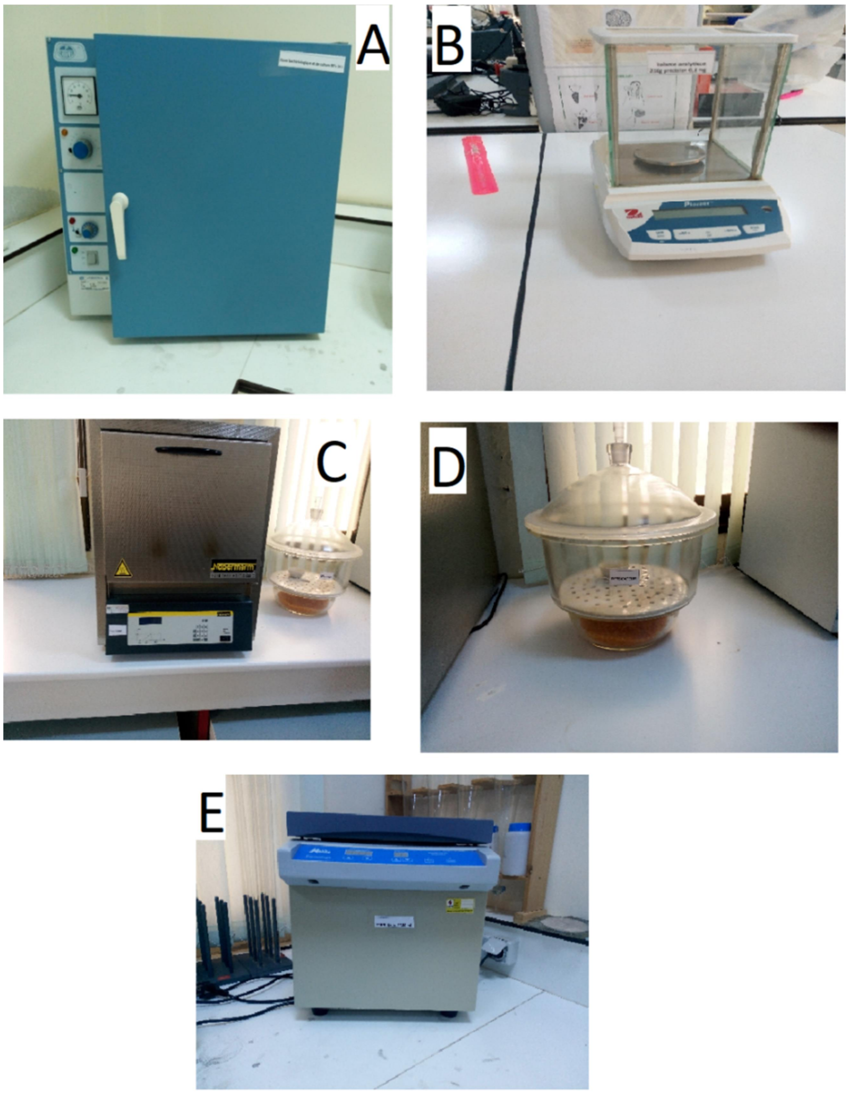

Fig 7. Oven (A); Scale (B); Furnace (C); Dryer (D); Centrifuge (E)

3.2.3. Sludge Index.

The aim of studying this index is to appreciate the aptitude of the sludge for decantation. The sludge index represents the volume occupied by one gram of sludge in a transparent test tube (test tube) graduated of 1 liter after 30min of static decantation, and is defined by the following equation :

$$SI = \frac{V_{30}}{TSS}$$

SI: sludge index; V_{30}: volume of decanted sludge; TSS: concentration of suspended solids of the decanted sludge in the test tubes in (g /l).

The sludge index is valid when the volume of decantation is between 100 and 300ml otherwise a dilution is necessary in this case, if the sludge index is calculated as follows:
TSS: Mass of dry matter of the decanted sludge after dilution.
If :
SI<100 corresponds to sludge that settles easily.
100<SI<200 difficult decantation (some filaments).
SI>200 poor decantation (filament-rich sludge).

3-2-4 The efficiency (R).

The calculation of abatement rate for a parameter R, expressed as a percentage, is calculated according to the following equation:

$$R = \frac{P_i - P_0}{P_i} 100$$

R: is the output for a given parameter; P_i: is the number of the given parameter at the input; P_0: is the number of the same parameter at the output)

4. RESULTS AND DISCUSSIONS

This part presents the main results of our physical-chemical analyses, in which we will introduce: the interpretation of the main results obtained by the different analysis techniques (water, sludge) at the level of the STEP of Bouira, during the year 2022 (February and March).
In order to evaluate the quality of the treated water from the plant, we compared our results with those of previous years. The results of the physical-chemical parameters of the raw wastewater and treated wastewater are analyzed and compared to the set thresholds of the STEP, and also interpreted in relation to the standards recommended by the OMS (Table.2) in order to evaluate the purification efficiency of the sludge treatment at the level of the Bouira wastewater treatment plant.

Technium Social Sciences Journal
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Table 2. OMS standard

Parameter	Norm
T°	30°C
PH	6,5-8,5
BOD_5	30 Mg d'O2/l
COD	90 Mg d'O2/l
TSS	30 Mg/l
Phosphate	2 Mg/l
Total Azote	50 Mg/l
Hydrocarbons	10 Mg/l
Oils and greases	20 Mg/l
Detergent	01 Mg/l
Zinc	02 Mg/l
Chrome	0,1 Mg/l

4.1 Water branch

This table shows the results of the physical-chemical analyses of the raw water (the water at the inlet of the STEP) and the treated water (the water at the outlet of the STEP) during the months of February and March.

Table 3. Analysis results (raw water / treated water) (source: survey)

Date	Raw water (EB)					Purified water (EE)				
	Cond (µs/c)	T°C	pH	TSS (mg/l)	BOD_5 (mg/l)	Cond (µs/c)	T°C	PH	TSS(mg/l)	BOD_5 (mg/l)
16-02-2022	1130	8,2	8,71	192	/	1188	12,9	8,28	102	/
17-02-2022	1187	6,8	8,78	208	200	1193	13	8,46	97	50
20-02-2022	1028	14,2	8,41	127	120	1187	14,4	8,5	156	50
21-02-2022	1166	8,3	8,56	224	/	1203	13,5	8,51	124	/
27-02-2022	1320	13,5	8,03	315	/	1235	11,5	8,51	218	/
28-02-2022	1320	13,3	8,7	443	420	1213	12,1	8,43	268	/
01-03-2022	971	7,2	8,73	/	180	1089	12,5	8,51	/	50
02-03-2022	1148	6,5	8,74	271	/	1128	12,2	8,41	84	/
03-03-2022	1145	6,3	8,83	163	340	1124	12,2	8,29	93	50
06-03-2022	1052	13	8,59	45	60	1089	12,8	8,43	56	37
07-03-2022	1104	9	8,98	/	/	1071	13,5	8,56	/	/
08-03-2022	1074	13,2	8,56	87	/	1130	13,8	8,5	26	/
09-03-2022	1186	7,8	8,74	/	220	1170	13,7	8,7	/	47
10-03-2022	1193	7,1	8,84	169	/	1181	13,6	8,55	29	
Total Average	1144,57	9,6	8,65	204	220	1157,21	13	8,47	113,9	47,33

4.1.1. Temperature.

Temperature is a very important factor in the physical-chemical properties of water. A warming or a cooling can strongly disturb the phenomena of water purification, but this change can also be a factor in the growth of microbial productivity.

Technium Social Sciences Journal
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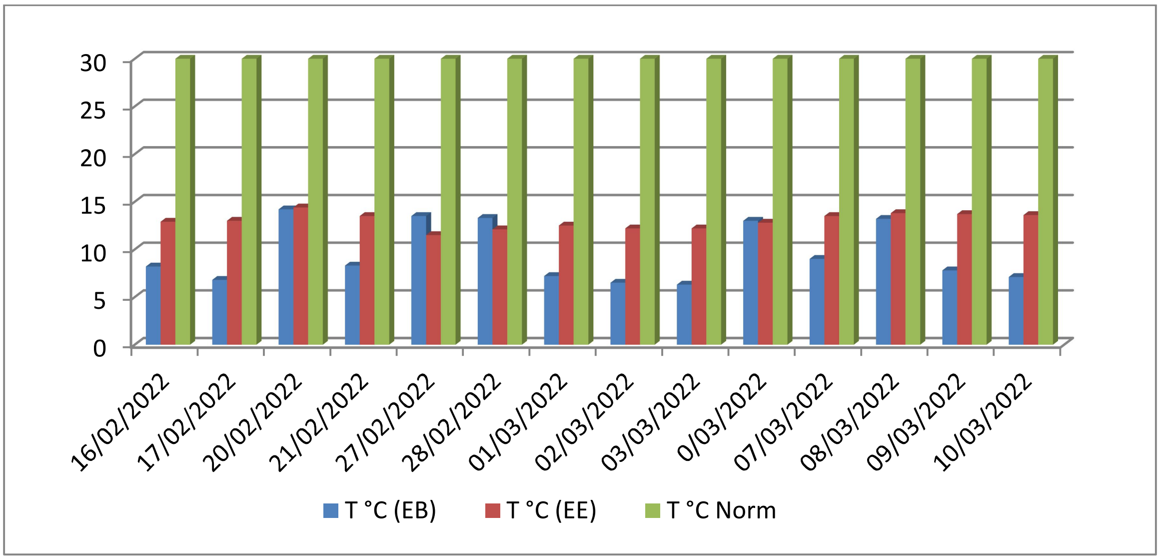


Fig 8. Temperature variation of raw water and treated water

According to the results obtained, we note that the temperature of the raw water varies between 6.3 and 14.2 °C with an average of 9.6°± 2.99 C. the temperature of the purified water varies between 11.5 and 14.4 °C with a total average of 12.97± 0.8 °C. In fact, these variations do not exceed the Algerian standard recommended by the OMS (World Health Organization).
The analysis of variance shows that the temperature of the treated water differs highly significantly from that of the raw water (P= 0.0007). This increase is due to the passage of the effluent through different stages of treatment and the direct exposure of the water to the sun in the decanters and filters during treatment.
According to the nominal values, and the objective of the purification, the temperature results show that it does not exceed the standards (12°c and 20°c).

4.1.2. Conductivity.

The results obtained for water conductivity show that there is a significant difference between the two types of water (P = 0.015). We notice that the conductivity of the raw water fluctuates between 971 and 1320 µS/c and that of the purified water fluctuates between 1071 and 1235 µS/cm. It can be deduced that the raw water contains a very high pollution load with an increase in the use of chemicals during the treatment process.
Figure 09 shows us that the conductivity is a function of temperature, if we increase the temperature, the conductivity will also increase, and even in the opposite case.

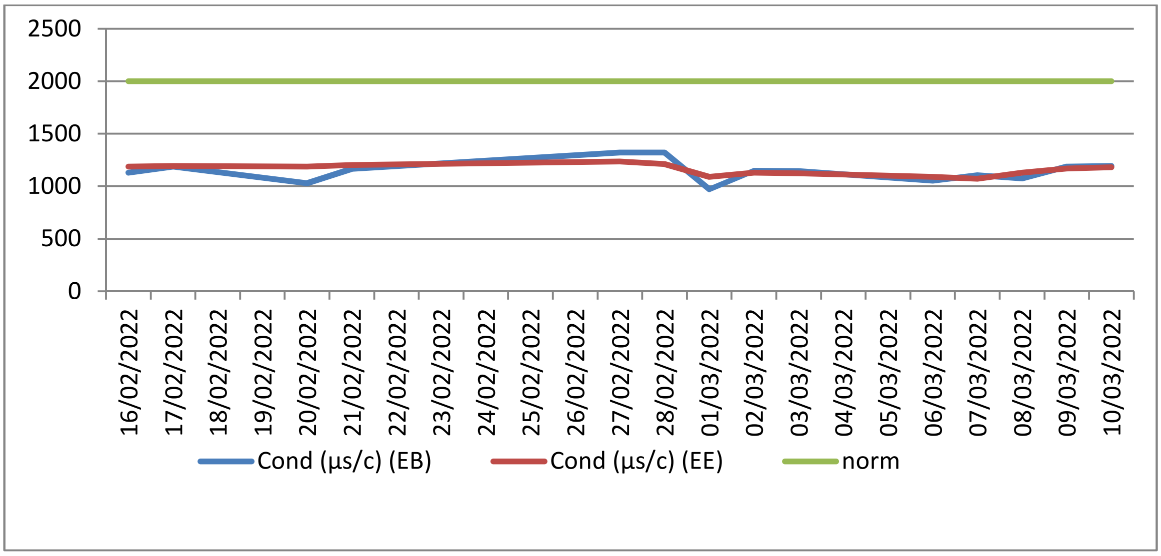


Fig 09. The conductivity of the raw water and the purified water.

4.1.3. PH.

The PH of the water depends on the nature of the micro-organisms. A PH between 6 and 9 is an ideal PH for the maintenance of the life of the micro-organisms populating the aeration tanks[26]. An alkaline PH and a moderate temperature constitute ideal environmental conditions for the reproduction of micro-organisms which establish a perfect biological balance, allowing the organic matter to degrade which leads to the decontamination of the water.

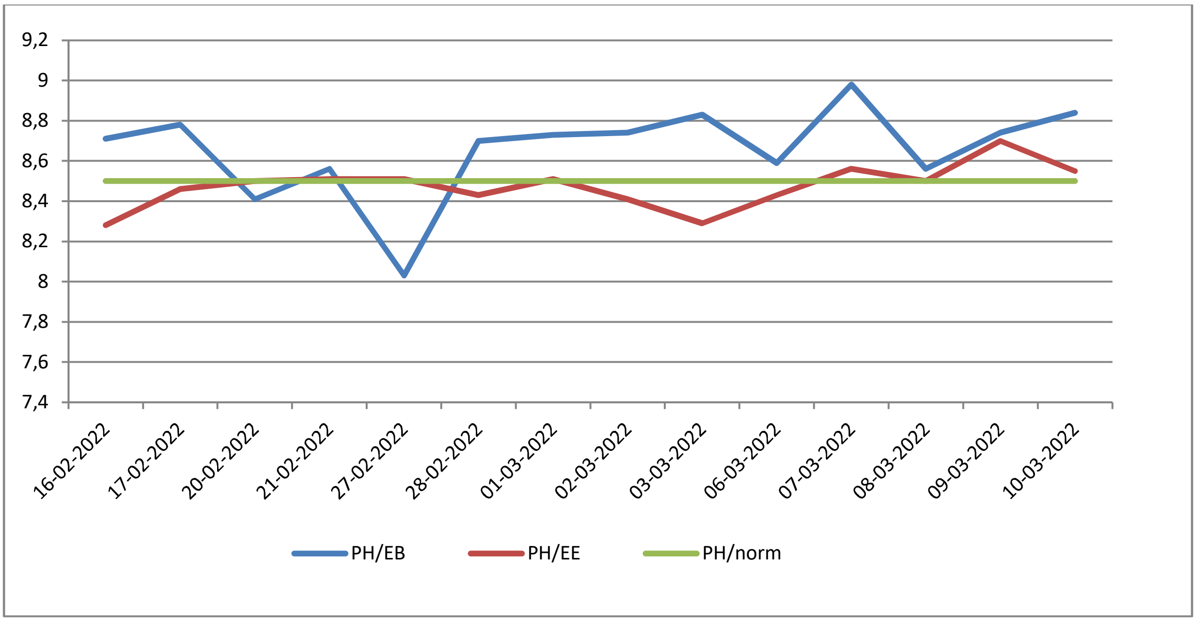


Fig 10. PH of the raw water and the purified water

PH of the raw water varies between 8.03 and 8.98 with a mean of 8.65± 0.2 and that of the treated water varies between 8.28 and 8.7 with a mean of 8.46±0.1. The analysis of variance shows that this difference is significant (P= 0.008). Indeed, this pH exceeds the Algerian standard recommended by the OMS, which is between 6.5 and 8.5. Indeed, this result may be due to a malfunction of the processor, which also explains that the water is not well purified.

4.1.4. Suspended solids (TSS).

The following table gives us the concentrations of TSS, TSS average, and the removal efficiency of the raw water and the treated water.

Table 4. TSS values of raw and purified water (Source: survey)

Date	TSS		Efficiency
	EB	EE	
16-02-2022	192	102	46,87
17-02-2022	208	97	53,36
20-02-2022	127	156	-22,83
21-02-2022	224	124	44,64
27-02-2022	315	218	30,79
28-02-2022	443	268	39,5
02-03-2022	271	84	69
03-03-2022	163	93	42,94
06-03-2022	45	56	-24,44
08-03-2022	87	26	70,11
10-03-2022	169	29	82,84
MES	204	113,9	/
Rendement épuratoire	/	/	39,34

The recorded values show a decrease in TSS between the raw and treated waters. At the entrance of the plant, the TSS varies between 45 to 443 mg/l with an average of 204 ± 110.5 mg/l after water treatment, its TSS contents vary between 26 to 268 mg/l with an average of 113.9 ± 75.1 mg/l, noting a total yield that reaches 39.34 (fig.13). The fluctuations recorded between the TSS values of the raw water may be due to the nature of the effluent. These results show that the TSS exceeds the Algerian standard recommended by the OMS which is 30 mg/l.

The average TSS content of the purified water is higher than 30 mg/l, so it does not meet the set limit of the plant which is 30 (mg/l) (fig.11).

From these results, we can say that the treatment is not well done, by what we found the TSS in the purified water is higher than 30 mg/l, this can be due to the negligence of cleaning the automatic sampler and also due to a processor malfunction.

The yields obtained show that there is not a good removal of TSS between raw water and treated water. This means that there is not a good separation between the sludge and the treated water at the clarifiers.

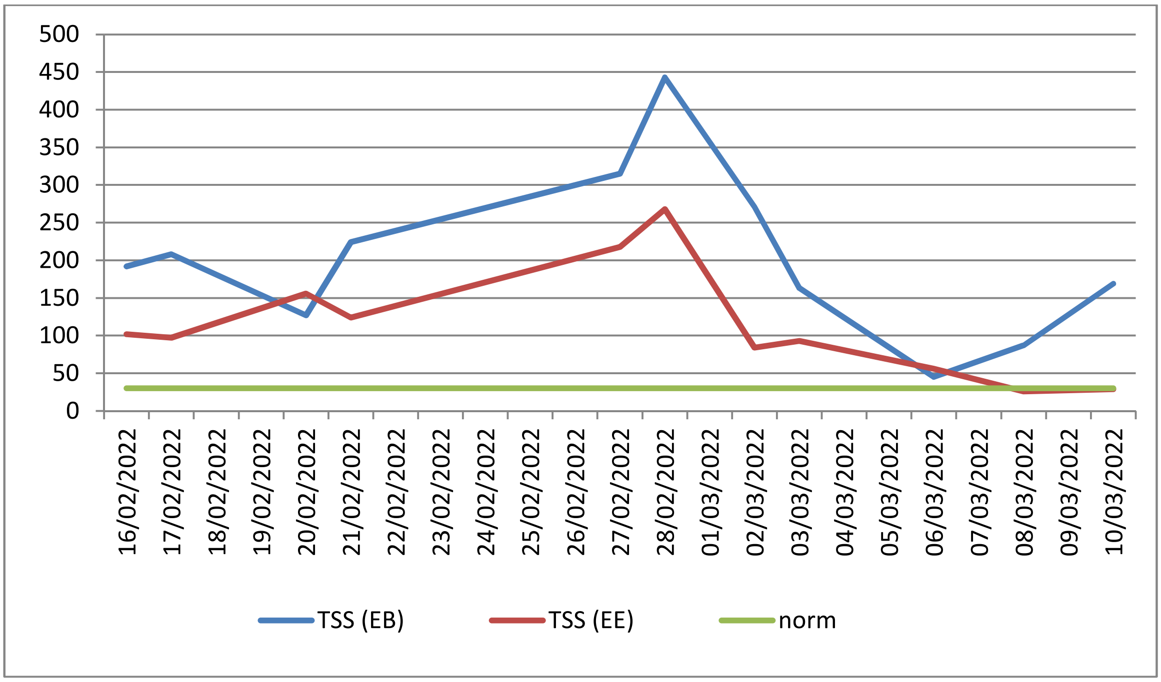


Fig 11. Variation of TSS of raw water and purified water

4.1.5 Organic pollution parameter (BOD_5).

The average value of the pollutant load (BOD_5) of wastewater received by the plant varies between 60 to 420 of O_2/l. After treatment, (at the plant outlet) its values vary between 37 to 50 mg of O_2/l. (Fig.12). These values show that the DBO_5 exceeds the Algerian standard recommended by the OMS which is 30 mg of O_2/l.

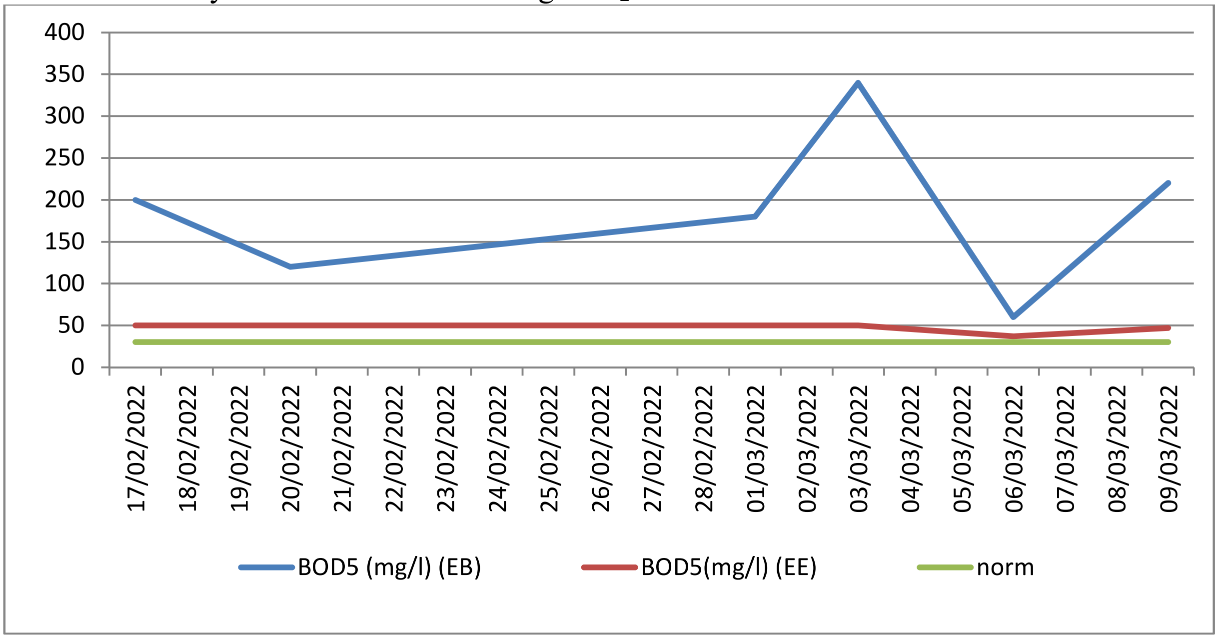
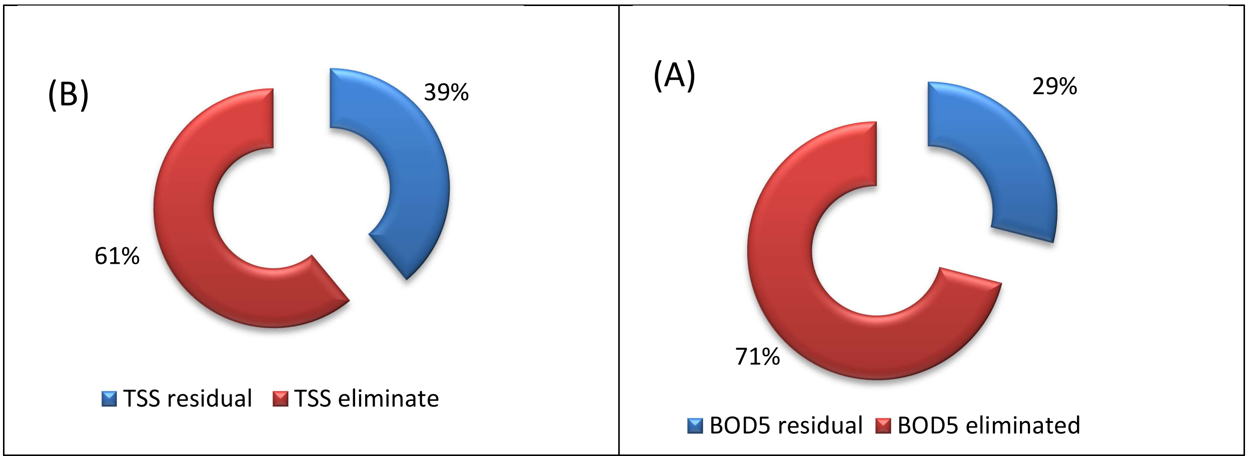


Fig 12. Variation of BOD_5 of raw water and purified water

The average BOD_5 of the treated water is higher than 30 mg/l and therefore does not meet the contractual standard of the plant. This problem is due to the stopping of the two aerators in the biological basin, which led to a strong decrease in oxygen, which in turn led to incomplete biodegradation.



(B) **Fig 13.** BOD_5 removal rate (A), TSS removal rate

The reduction rates of the different parameters obtained in this study are represented by the figures below. The average pollution abatement rates are 71% for BOD_5 and 39% for TSS. These efficiencies were relatively unstable during the study period. This result confirms that the wastewater treatment system in the Bouira wastewater treatment plant is not reliable. Therefore, the treated wastewater is not suitable for reuse in agriculture (irrigation), or for discharge into the natural environment.

4.2 Sludge branch

4.2.1. Determination of TSS, MVS of return sludge and activated sludge.

The following table represents the V_{30}, DM, VSS, and SI values of return sludge and activated sludge.

Table.5 Values of TSS, VSS, return sludge, and activated sludge (Source: survey).

Date	return sludge				activated sludge			
	V_{30} Ml/L	DM G/L	VSS%	SI Mg/L	V_{30} Ml/L	DM G/L	VSS%	SI Mg/L
14-02-2022	/	20,44	51,87	/	190	3,64	27,85	52,19
15-02-2022	/	1,43	4,50	/	30	0,55	8,88	54,54
21-02-2022	/	0,92	3,04	/	30	0,67	9,33	44,77
28-02-2022	/	6,75	17,09	/	60	1,45	14,51	41,37
07-03-2022	/	9,43	23,47	/	180	4,23	39,40	42,55
Average	/	7,79	19,99	/	98	2,1	19,99	47,08

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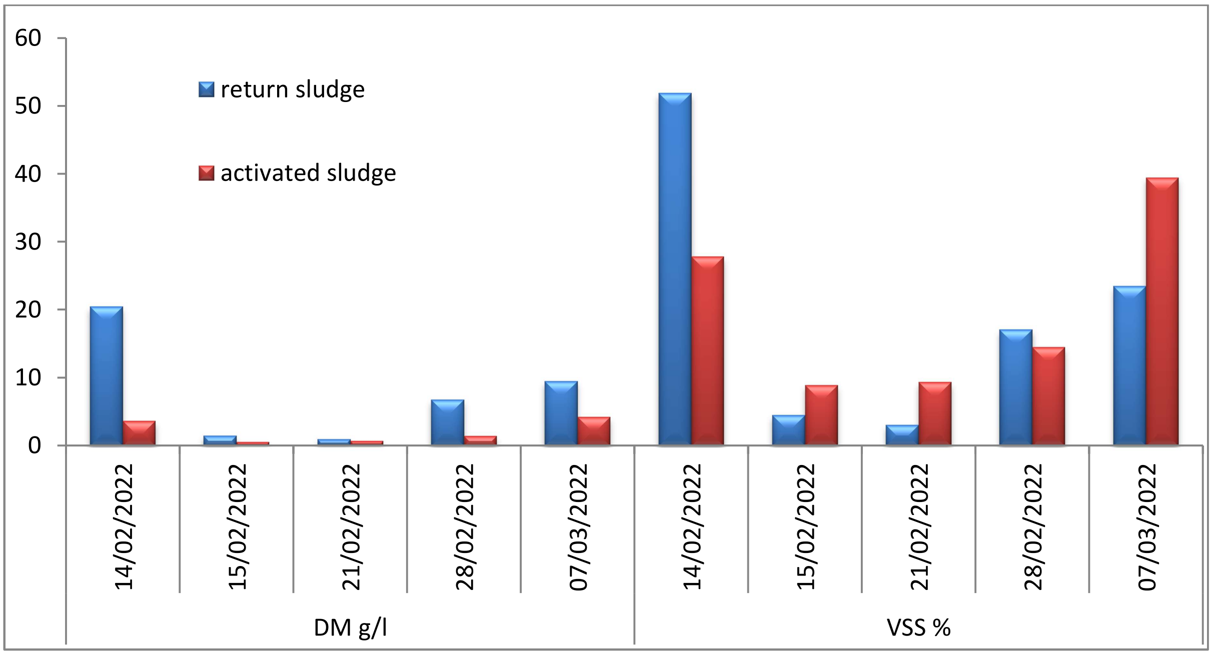

Fig 14. Variation of DM and VSS of Returned Sludge and Activated Sludge

The results of the return sludge DM concentrations range from 0.92 to 20.44 g/l in the dispenser with an average of 7.79 g/l. Return sludge VSS contents ranged from 3.04 to 51.87%.
The concentrations of DM, VSS, and activated sludge are variable. The DM values recorded vary from 0.55 to 4.23 g/l in the dispenser with a total average of 2.1 g/l. The VSS content varies from 8.88% to 39.40%, with an average of 19.99%. This value is lower than 50% which means that the sludge is not organic.

V_{30} : The values obtained are after dilution, they do not exceed 300 ml/l. The contents of V30 in the activated sludge vary between 30 and 190 ml/l, with an average of 98ml/l.

SI: According to the results obtained, the sludge index concentrations vary between 41.37 and 54.54 ml/g with a total average of 47.08 ml/g. The values of the sludge index are lower than 100ml/g, which means that our sludge is easily decanted at the clarifier level.

5. Conclusion

The presented work is a contribution to the evaluation of the processes of purification or treatment of wastewater in the wastewater treatment plant of Bouira, in a perspective of agricultural reuse and / or protection of the natural receiving environment.
However, the results obtained show that this operation causes negative impacts on the environment and human health. This imposes an integrated management of the latter by the station.
Indeed, the physical-chemical analyses obtained from the treated waters show that the temperature varies between 6,3°C a minimum recorded at the entrance and 14,4°C recorded at the exit, which offered favorable conditions for the development of aquatic species. The hydrogen potential exceeds the standards recommended in Algeria by the OMS.

The conductivity varies between 971µS/cm and 1320 µS/cm, which allow the water to be classified as fair. On the other hand, the TSS contents are higher, varying between 26 and 443 mg/l.
The TSS and BOD_5 values of the treated water show that it is unsuitable for agricultural reuse. It was found that the operation of the decantation basins of the STEP of Bouira varies from one year to another to reach their maximum in the next years. This increase can be explained by the increase in the urban pollution load (population number).
The purified wastewater from the Bouira plant is not suitable for reuse in agriculture (irrigation), or for discharge into the natural environment. We can therefore say that the treatment system adopted by this plant is not 100% efficient. It is advisable to regularly carry out this type of research based on the physical-chemical evaluation, but in association with bacteriological analyses.

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