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Downstream physico-chemical and bacteriological investigation of wastewater of Oued Athmania treatment plant

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Abstract

Wastewater treatment is a very important process that consists of applying modern and new technology to improve or upgrade the quality of a wastewater because its disposal whether by surface, subsurface methods or dilution, is dependent on its treatment. In the present work a full study has been carried out dealing with the physicochemical and bacteriological properties of wastewaters after being treated in ***Oued Athmania*** *Wastewater Treatment Plant. The results revealed that the findings are in conformity with the international standards.*

Key words*: wastewater, physicochemical, bacteriological, properties.*

1. Introduction

Usually wastewater treatment will involve collecting the wastewater in a central, segregated location (the Wastewater Treatment Plant) and subjecting the wastewater to various treatment processes.

Water is the most important and indispensable natural resource for life. Therefore, the conservation of clean and suitable water resources for different uses is a national responsibility so as to assure protection and safety for the environment. Nevertheless, the ever-increasing demographic growth has led to intensive urban farm and various activities across all Algerian cities during the last decade. These activities have induced a drastic raise of domestic untreated wastewaters which may cause a spread of serious diseases. For this purpose, wastewaters require treatment before being rejected in nature to rid it from polluting organic matter and microorganisms, including bacteria, (Salmonella-sp, E.coli, Vibrio cholera) or a virus (polio, hepatitis A and B).

Whatever the type of treatment used in wastewaters technology, it usually goes through three successive steps:

1 - An initial physical treatment aiming to eliminate 20 to 30% of the non-dissolved solids through screening or sedimentation.

2 - A secondary purification (biological treatment) to get rid of dissolved organic matter. This treatment depends on the ability of micro-organisms to dissolve the contaminated organic matter. The active sludge method is the most widely used and the most effective.

3 – A biological and / or physical treatment to get rid of nitrogen or inorganic phosphorus or other chemical materials.

After being purified physically and biologically, wastewaters are usually cleaned using chlorine to eliminate the pathogenic micro-organisms.

Several measurements have to be conducted before making any appropriate decision for treatment, including: BOD_5 (biological oxygen demand), COD (chemically oxygen demand), SM (suspended material)

2. Materials and methods

During our study, we have performed the following physicochemical and bacteriological characteristics of the wastewaters of **Oued Athmania** station (Mila) before and after treating the water using the active sludge method.

2.1. Physicochemical analysis [1,2]

1. Temperature: using a thermometer.
2. pH: using a pH-meter.
3. COD: to measure the COD of treated water, we used tubes with $K_2C_2O_7$ or $KMnO_4$. However for non-treated water we used tubes with Hg_2SO_4. After heating the tubes at 150°C for two hours and then cooled, COD values are read using a spectrophotometer.
4. BOD_5: each sample of treated and untreated water was put in a glass bottle and well stirred before being put in a BOD-meter and left for an hour. Then NaOH tablets were added to absorb CO_2 and BOD_5 rates were recorded after 5 days of incubation.
5. Suspended materials (SM): these materials are measured using a Spectrophotometer.

2.2. Bacteriological Analysis [3,6]

These analyzes were conducted by looking for fecal pollution indicators and some pathogenic bacteria (Salmonella).

Since the wastewater is rich in micro-organisms, it is subjected to many special treatments before bacteriological analysis.

1. Find the Coliform bacteria and the fecal Coliform bacteria according to the two steps:

- **Presence Test**

We have used a BCPL medium (with **Durham**) by using different concentrations of three consecutive dilutions of the water so we can read the more likely number by referring to the **Mac Grady** table. Samples are incubated at 30-35 °C for 24-48 h.the color Change of the medium with production of gas highlights the possible presence of the coliform bacteria.

- **Confirmatory test**

Tubes were seeded in Shubert medium containing Durham from positive BCPL tubes. Sample is incubated at 40-44 °C. Kovacs detector is added to tubes containing turbidity and gas production. Formation of a red ring indicates the presence of fecal Coliform bacteria, especially E-coli.

2. Detection of fecal Streptococcus bacteria

Detection of these bacteria is based on two stages:

- **Presence test**

Tubes were seeded with Rothe at different concentrations for three consecutive dilutions. The sample is incubated at 37 °C. Samples that exhibit certain turbidity indicate the presence of fecal Streptococcus bacteria.

- **Confirmatory test**

Tubes were seeded with Litsky medium from Rothe tubes and incubate for 24-48 h at 37 ° C, a violet ring reveals the presence of fecal streptococcus bacteria.

3. Presence Of Salmonella Bacteria

These pathogenic bacteria are detected in two steps:
Samples are seeded in the liquid environment SFB: and then incubated at 37 °C.
Samples are seeded in Hectoen environment: from SFB positive tubes is seeded Hectoen medium then are incubated at 37 °C for 24-48 h.The appearance of green or blue spots with black or non-black centers indicate the presence of *Salmonella* bacteria but this must be confirmed using biochemical analyses.

3. Results and discussions

Table 1: physicochemical results before and after treatment

Sample	1		2		3		4		5		6	
	Before	after	Before	after	before	after	before	after	before	after	before	After
characteristics												
T°	16.5	17	17.3	17	18	19	17.5	18	19	18	17.5	17
pH	7	7.5	7	7	6.8	7	7.5	6.6	7.9	7	6.9	7
SM: mg/L	457	17	286	12	306	22	278	10	291	17	325	10
COD: mg/L	522	54	426	45	700	36	444	62	413	66	361	46
BOD: mg/L	270	35	230	16	250	37	210	11	230	26	200	14

3.1 Physico-chemical results before and after treatment

- Temperature: recorded Temperatures ranged between 16-19 °C for treated and untreated water and hence the values did not exceed standards (25 °C).
- pH: The values show that the treated water and untreated water was neutral, as the recorded values ranged between 6-7.
- COD: For untreated wastewater we recorded considerable values for chemically absorbed oxygen ranging between 361-700 mg / l. this indicates the presence of significant pollution with organic or inorganic compounds. In the other hand, we recorded a significant lack of chemically absorbed oxygen COD for the wastewater after the treatment station with a range of 36-66 mg/L and the results are consistent with the standards which stated that the COD of the treated water should be between 120-90 mg/l.
- BOD5 of untreated domestic wastewater showed large values ranging between 270-200 mg/l, which confirms the richness of this water with bio-oxidable contaminated organic matter.
- After treatment we noticed a large decrease in the BOD5 as we recorded values ranged between 11-37 mg/L which is in conformity with the standards for treated wastewaters (40-20 mg/l)..

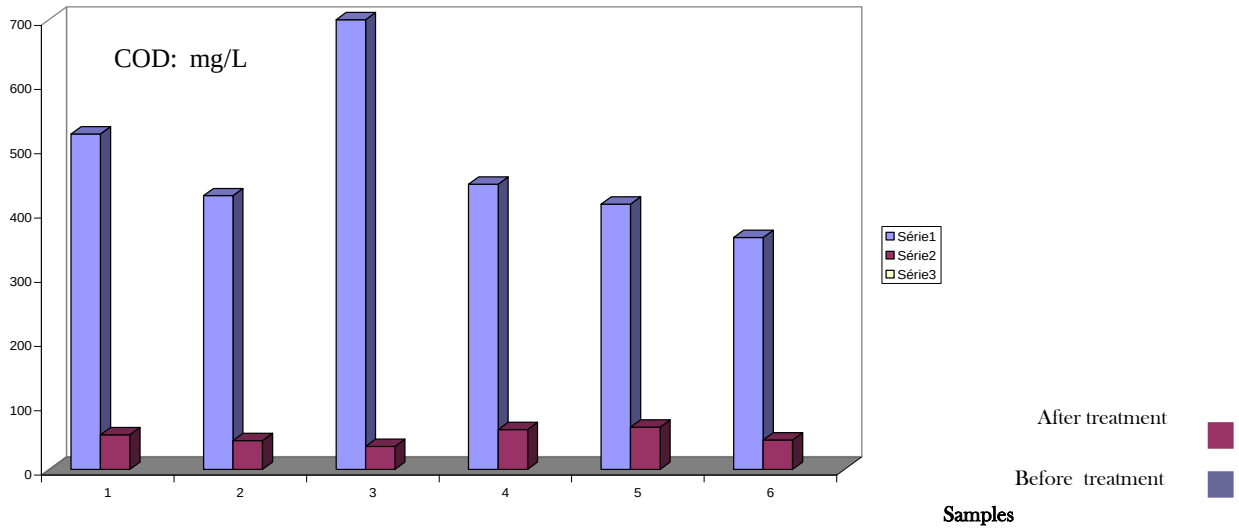

Figure 1. DCO values before and after treatment

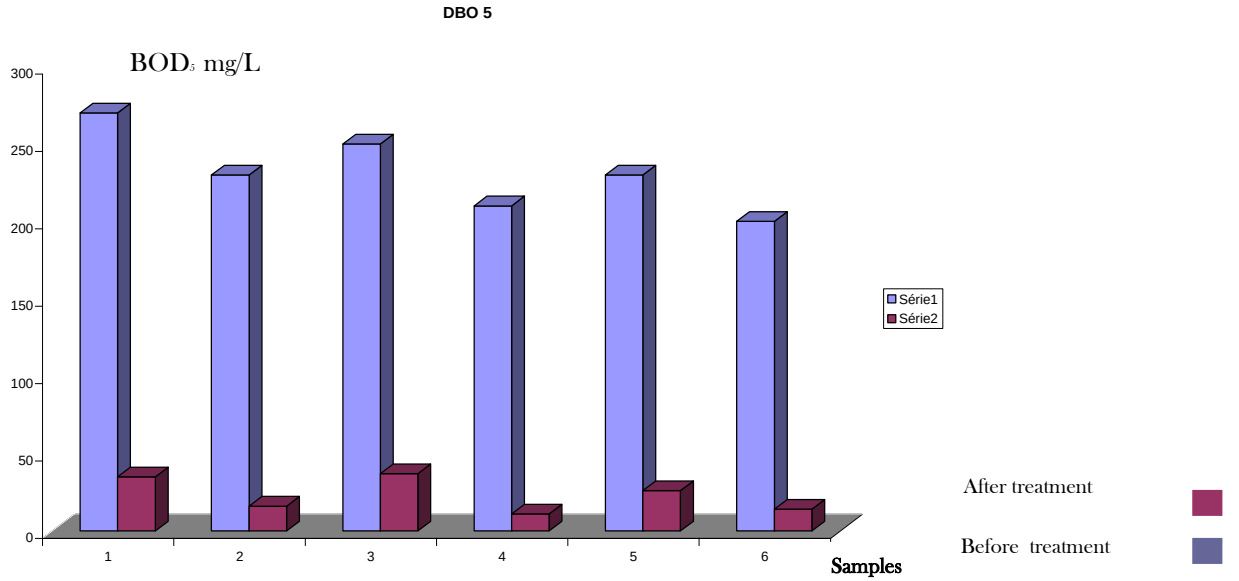

Figure 2. BOD_5 values before and after treatment

➢ SM: the amount of suspended material recorded after treatment is significantly lower than that recorded after treatment as a large part is eliminated during the first and second deposition processes.

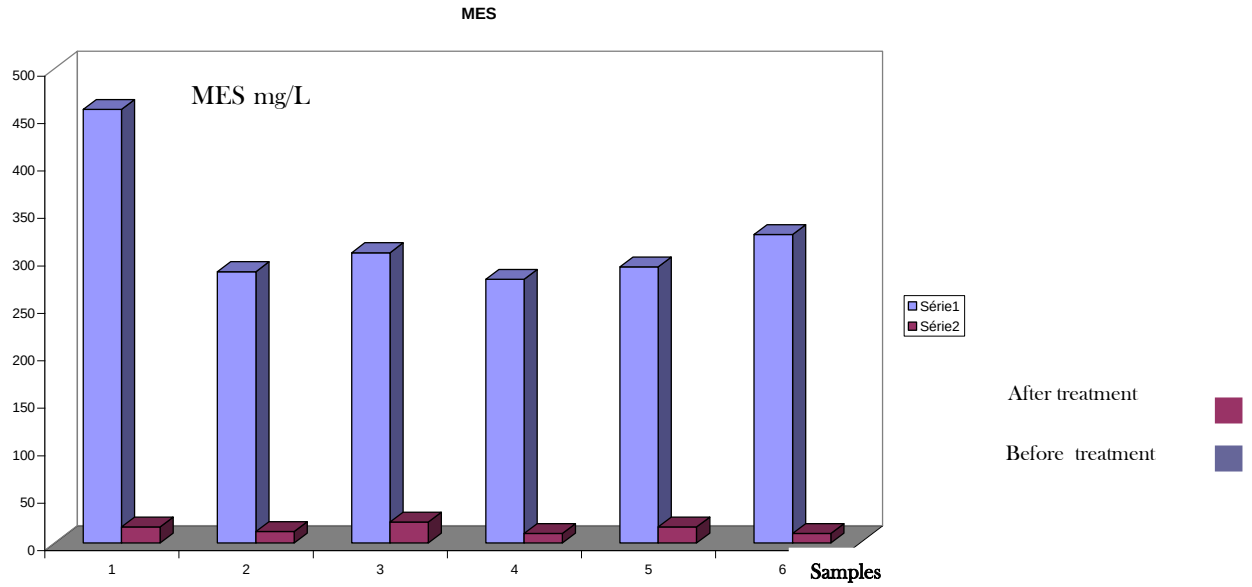

Figure 3. SM Values before and after treatment

3.2. Bacteriological results

1. Coliform bacteria: The results showed a color change of the medium with the production of gas, indicating the possible presence of these bacteria in the treated and untreated waters.
Seeding with Shubert gave microbial turbidity and after the addition of Kovacs reagent gave a red ring, which indicates the presence of bacteria fecal Coliform bacteria, especially E. coli that has been identified using the biochemical analysis. We recorded very high numbers of these bacteria in untreated wastewaters, however in the treated water we recorded a significant shortfall due to the fact that these bacteria belongs to the active sludge which oxidizes and dissolves organic matter.

2. Fecal *Streptococcus* bacteria: we recorded the presence of fecal Streptococcus bacteria in wastewater before and after treatment, but always with the largest number in untreated water. These bacteria are also active in the formation of sludge, which has led to their decrease after treatment.

3. *Salmonella* bacteria: Our results showed the absence of Salmonella bacteria, either in treated or untreated wastewater.

Table 2: Effectiveness of the treatment:

	Decrease rate					
Sample	1	2	3	4	5	6
MES	95	95	92	96	94	96
COD	89	89	95	86	84	87
BOD5	87	93	85	72	89	93
Coliform	45	93	75	50	76	89
Streptococcus	48	60	45	97	72	41

The results in table 2 confirm the effectiveness of the treatment carried out in **Oued Athmania** station.
The Results show a significant lack of the organic matter through BOD_5 values as we recorded a decrease rate ranged between 87 and 93%.
According to H. Leclerc **[6]** the purification of wastewater in appropriate circumstances using the sludge method often exceeds 90%.

We recorded also a significant decrease of suspended material (by approximately 95-96%) and lack of organic matter and mineral chemically oxidable with a rate ranged between 84-95%.
We have also a very significant decrease ranged between 54-93% of Coliform bacteria and 60-97% of *Streptococcus* bacteria.

4. Conclusion

Through the above results we can emphasize that rejection of the water after treatment to the environment will not affect the ecosystem or impair the health of the citizens, but we recommend cleaning the water using chlorine after treatment in order to ensure the absence of any harmful bacteria that may lead severe damage to the health.

We also emphasize the effective treatment of active sludge remained after treatment because it contains a huge number of micro-organisms, which can be pathogenic because the only method used in Algeria is to expose it to sun rays. So we incite the concerned authorities to provide the purification station with modern technology in order to make use of sludge and to use it as a source of fertilizer.

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