Indonesian Journal of Science & Technology 6 (2) (2021) 361-370

Indonesian Journal of Science & Technology

Journal homepage: http://ejournal.upi.edu/index.php/ijost/

Physico-chemical investigation of wastewater from the Sebdou-Tlemcen textile complex North-West Algeria

Asma Khelassi-Sefaoui[1], Abderrahmane Khechekhouche[2], Manel Zaoui-Djelloul Daouadji[3,4], Hamza Idrici[3]*

[1]Department of Hydraulic, Institute of Sciences and Technology, University Center of Maghnia, Algeria
[2]Technology faculty, University of El Oued, Algeria
[3] Department of Chemistry, Faculty of Mathematics & Matter Sciences, University of Kasdi Merbah, Algeria
[4]Pollution and waste Treatment Laboratory, University of Kasdi Merbah, Algeria

Correspondence: Email : khelassi_asma@yahoo.fr

ABSTRACT

Wastewater treatment is a process used in several countries, particularly in Algeria. A study on Earth for one month was carried out at the sewage plant of the Sebdou textile complex, Tlemcen, north-west of Algeria. Regular samples gave average values at the outlet such that the water temperature is 22 ° C, the ph 7.43, the biochemical oxygen demand BOD5 is 36.5 mg / l, the chemical oxygen demand COD vary between 100 and 200 mg / l at the exit of the WWTP mg / l and finally suspended solids SS is of the order of 36.2 mg / l. All these values conform with the standards and therefore the treatment plant operates within Algerian standards.

ARTICLE INFO

Article History:
Submitted/Received 06 Dec 2020
First revised 30 Mar 2021
Accepted 23 May 2021
First available online 28 May 2021
Publication date 01 Sep 2021

Keywords:
BOD5,
COD,
pH,
SS,
Temperature,
Textile,
Wastewater.

1. INTRODUCTION

Water is an essential element for the life and the real and sustainable socio-economic development of a country (Westall & Brack, 2018). Water treatment in general directly affects human life and of course their environment. This treatment can be presented in several forms, the least known is solar treatment and the more well-known is the treatment of physicochemical and biological wastewater (Khechekhouche *et al.*, 2020 A, 2020 B, 2020 C; Kishor Kumar *et al.*, 2020; Yahiaoui *et al.*, 2020; Kim *et al.*, 2019). One of the sources of wastewater is the industry. The textile industry specifically is one of the industries that consume large amounts of water and have reported that this amount is in the order of 200 liters of water per kilogram of finished textile product (Nguyen & Juang, 2013). This textile sector, therefore, generates effluents characterized by a significant load of organic matter which requires treatment before their discharge into the receiving environment (Belbahloul, *et al.*, 2014).

Nowadays, protecting the environment is a major problem for mankind. Textile mill effluents are complex mixtures of chemicals, the composition of which differs over time and depending on the facility. They can have high concentrations of suspended solids and metals, as well as dyes and surface-active molecules (Heba & Eman, 2020). The textile industry uses around 10,000 types of dyes, the majority are recalcitrant organic molecules generally presenting problems of color, high concentrations of BOD5, COD, suspended solids MES, as well as high toxicity and conductivity. Several purification processes have been tested, for example, the biological processes and the most used being the activated sludge treatment due to its simplicity and its economy and which allows obtaining significant purification results (Imane Bencheikh *et al.*, 2021). Chlorine is considered to be the most widely used chemical agent in the world for disinfecting water, which has saved millions of lives from water-borne diseases (Weinberg *et al.*, 2006). However, water chlorination may result in the generation of by-products which may be toxic to humans (Shammas *et al.*, 2005).

The objective of this work is to evaluate the purifying power of a physicochemical treatment plant of the discharges of an industrial textile unit E.A.T.I.T Sebdou, North-West Algeria.

2. MATERIALS AND METHODS

The sewage treatment plant of the Sebdou textile complex depends on the textile industries company DENIM (the technical word for blue jeans) and is located in Sebdou (western Algeria), 37 km south of Tlemcen. This economic and public SPA company with the legal form of a"joint-stock company" aims to produce and market fabrics (denim blue, gabardine and military fabrics). The date of the start of construction was in 1976 and the date of commissioning of the complex was in 1979.

2.1 Presentation of the wastewater treatment plant

The treatment in this station goes through several phases shown schematically in **Figure 1**.

Figure 1. Schematic diagram of the physicochemical treatment process in the station of the textile industrial unit.

2.2. Wastewater and industrial water purification processes in the station

- **Screening**: Placed in the lifting stations, these baskets are suspended in front of the downstream end of the inlet pipe. This material often equips small installations (<5000 eH). However, they can be found in the largest factories as a backup for automatic screening devices.
- **Sandblasting**: Its function is the removal of sand and heavy materials. This is to ensure removal by sedimentation of sands and heavy materials to prevent abrasion of mechanical equipment and deposits in the pipes and the bottom of the basins (clogging, reduction of useful volumes).

2.3. Mixing and equalization basin n° 1

This basin as shown in **Figure 2**, is used for equalization and mixing of textile wastewater, steam production, rinsing filters, regeneration wastewater). Remembering coarse materials (fibers, pieces of fabric), it was placed in the basin of a special screen (moisturize) (Q = 200 m^3/h). 04 immersible aerators mix the water and supply oxygen before this water is introduced into the neutralization tank (1) by the immersible pumps (of the same Q and same H). Aeration (or oxygen supply) is intended to mix and prevent anaerobic putrefaction, in the case of longer residence times or less wastewater.

The level is adjusted via the contacts. The switch should be adjusted so that at least 1 m of water covers the submersible aerators. In normal operation, only one pump is running.

DOI: https://doi.org/10.17509/ijost.v6i2.34545
p- ISSN 2528-1410 e- ISSN 2527-8045

At maximum load, a second pump is started at the highest level.

2.4. Rapid mixing and neutralization basin (physicochemical treatment)

The neutralization basin as shown in **Figure 3**, is used to adjust the pH value and keep this selected value (control center setting), sulfuric acid (H2SO4) or lime hydrate (Ca (OH)) a solution inert has a pH value = 7. Acid solutions have a pH value of less than 7. To neutralize such a solution, a detergent is dosed in this case with a bed of 5% lime. Basic solutions have a pH value greater than 7. And are neutralized with an acid (10% sulfuric acid). In the neutralization tank, a pH value measurement continuously measures the pH value.

2.5. Flocculator-clarifier (separation of sludge and clear water)

Figure 4 shows the flocculator-clarifier. The chemical flocculation taking place in the clarifying flocculator largely eliminates the dye content of the wastewater, in addition to a large part of other pollution. Fine suspended particles and colloidal particles are deposited. At the same time, any toxic sulphite ions present react with the iron ions of the ferric chloride to form insoluble iron sulphide which simultaneously settles in the flakes.

All heavy metal ions present are reduced to insoluble hydroxide and removed with the ferric oxide hydrate flakes. By the two preceding methods, practically complete elimination of these toxic elements is obtained.

2.6. Biological treatment basin

Figure 5 shows the biological treatment basin. During the activated sludge treatment process, chemically treated and clarified wastewater is aerated and thoroughly mixed, and then recycled to the activated sludge basin. Floating sludge flakes (biozones) remove organic pollutants from wastewater and deposit them in post-clarification ponds. Biologically formed flocculated sludge develops many small organisms, including bacteria, hence its name activated sludge.

2.7. Final clarification basin

For the final clarification process, we use the law of gravity according to which materials heavier than water, in this case, the mud flakes fall in that direction. This mechanical process takes place in 2 circular clarification basin as shown in **Figure 6a**.

Figure 6b shows the post-chlorination basin where water inoculated with chlorine (Cl2) is added to the clarified water flowing in free fall out of the final clarification basin. There everything is mixed using a stirrer.

Figure 2. Photo of mixing and equalization basin N ° 1.

Figure 3. Mixing and neutralization basin N °2.

DOI: https://doi.org/10.17509/ijost.v6i2.34545 |
p- ISSN 2528-1410 e- ISSN 2527-8045 |

Figure 4. Clarifying flocculator.

Figure 5. Biological basin (aeration basin).

Figure 6a. Final clarification basin.

Figure 6b. Post chlorination basin.

3.RESULTS AND DISCUSSION

3.1. Temperature

Temperature is an important ecological factor in aqueous media. Its rise can strongly disrupt aquatic life (thermal pollution). It plays an important role in nitrification and biological denitrification. Nitrification is optimal for temperatures ranging from 28 to 32 ° C on the other hand, it is greatly reduced for temperatures of 12 to 15 ° C and it stops for temperatures below 5 ° C (Behera *et al.*, 2020). According to the results obtained in **Figure 7**, we note that the water temperature varies between 20 ° C and 25 ° C at the entrance to the WWTP with an average of 22.5 ° C while at the exit it oscillates between 15 ° C and 18 ° C with an average of 16.5 ° C. It can be seen that the water temperature values at the outlet of the WWTP do not exceed the authorized standard of 30 ° C (Tom *et al.*, 2020).

3.2. Water pH

In nature, bacteria can grow over a wide pH range of approximately 5 to 8. However, their optimal growth and activity are around a pH of 7.5 to 8.50, that is, is the case with our operating conditions in the basins. The pH values of the treated water, which vary between 7 and 7.5 with an average of 7.17, so they are lower than those of the raw water which varies between 10.5 and 14 with an average value of 12.1 as shown in **Figure 8**. The pH values at the outlet are very close to neutrality and they are relatively constant and do not exceed the authorized standard for industrial discharges (pH 6.5 to 8.5).

DOI: https://doi.org/10.17509/ijost.v6i2.34545
p- ISSN 2528-1410 e- ISSN 2527-8045

3.3. Suspended matter (SS)

Figure 9 shows the variation in the (SS) of raw and treated water at the entry and exit of the WWTP. The passage of the effluent in a purification station makes it possible to reduce the SS of the treated effluent from 380 mg / l to an average value of 36.2 mg / l satisfactory compared to the value of the Algerian discharge standards which is 30 at 40mg / l. The reduction rate reaches a yield of 88.15%.

3.4. Biological oxygen demand (BOD5)

Figure 10 shows the variation of the BOD5 of the treated raw water at the outlet of the WWTP. The textile industry discharges water with a BOD5 value of 150 mg / l. The BOD5 values at the outlet of the WWTP range from 28 mg / l to 44 mg / l with an average of 30 to 40 mg / l of 36.5 mg / l. It can be seen that this value does not exceed the authorized standard of 30 to 40 mg / l.

3.5. Chemical oxygen demand (COD)

The textile industry rejects aux with a COD value of 250 mg / l. We observe in the figure, a significant decrease in COD during the treatment of the effluent in a WWTP. The concentration is reduced from 828.4 mg / l to 154.4 mg / l. This COD value does not exceed the authorized Algerian standard which is 250 mg / l, as shown in **Figure 11**.

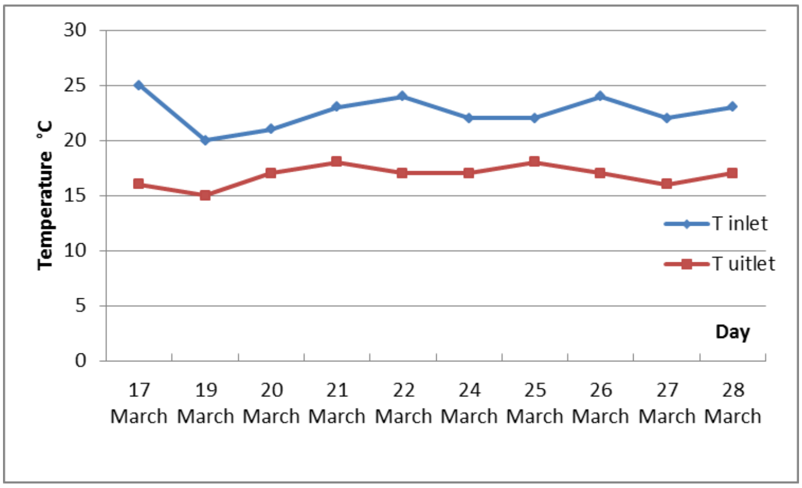

Figure 7. Water temperature variation in the treatment plant.

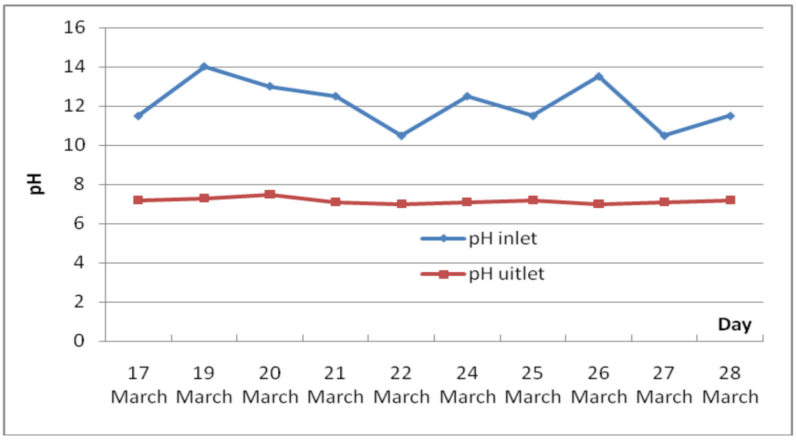

Figure 8. Change in the hydrogen potential (pH) of the water in the treatment plant.

DOI:https://doi.org/10.17509/ijost.v6i2.34545 |
p- ISSN 2528-1410 e- ISSN 2527-8045 |

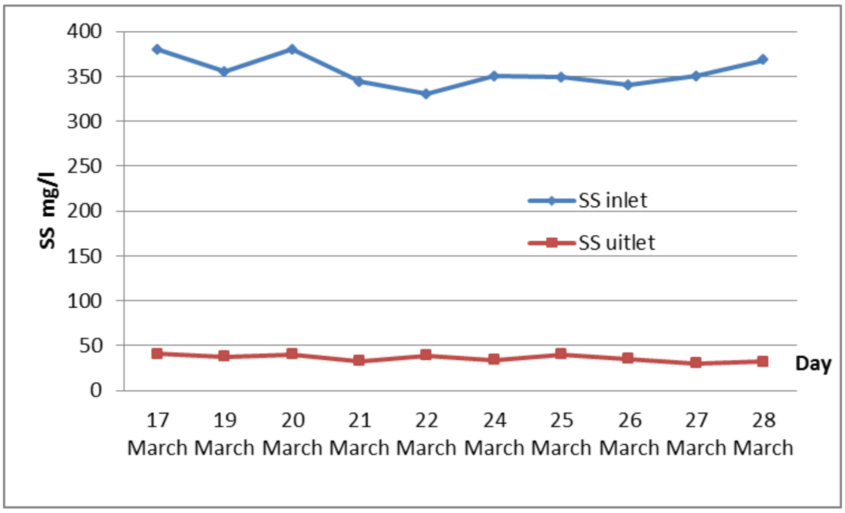

Figure 9. Variation in the (SS) of raw and treated water from the WWTP.

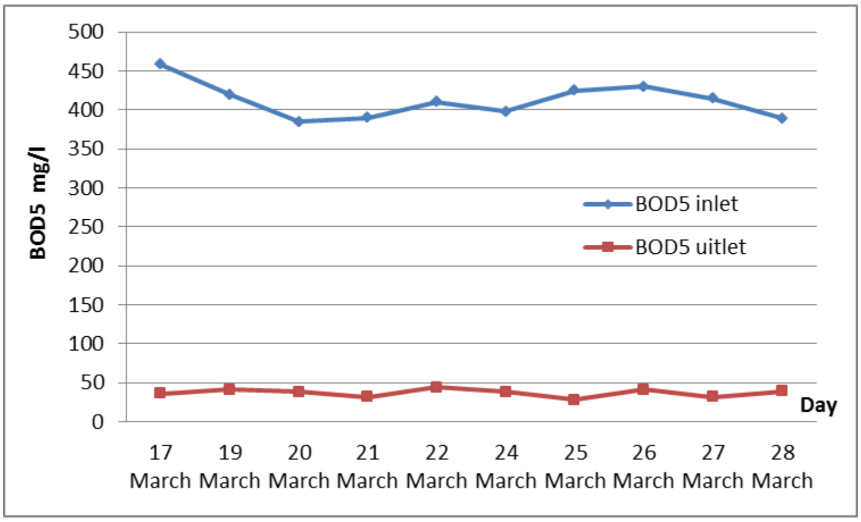

Figure 10. Change in BOD5 of treated water from the WWTP.

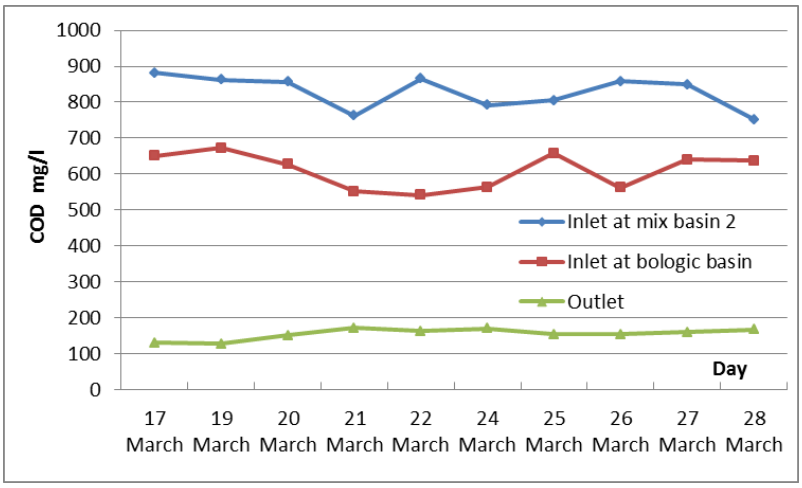

Figure 11. Change in COD of raw and treated water from the WWTP.

DOI: https://doi.org/10.17509/ijost.v6i2.34545
p- ISSN 2528-1410 e- ISSN 2527-8045

The value of the COD / BOD ratio indicates the coefficient of biodegradability of an effluent, it also makes it possible to define its origin (Suschka & Ferreira, 1986). Usually, the COD value is:

COD = 1.5 to 2 times BOD for urban wastewater;

COD = 1 to 10 times BOD for all of the wastewater;

COD> 2.5 times BOD for industrial wastewater. (The results are shown in **Table. I**).

3.6. Sedimentation at the outlet of the flocculator

Figure 12 shows the daily variation in sedimentation at the outlet of the clarification basin and the inlet of the biological treatment basin of the WWTP. It should be noted that the results obtained and presented in the figure vary between 82% and 99%. This result indicates the good role of the flocculator. There is a wide variation in the sedimentation of the sludge at the entrance to the biological basin, varying between 32 and 90%. This refers to emptying the tub now and then as the basin drain has been designed to keep around 30% of the mud in that basin.

Table 1. The COD and BOD values for the last week of the month (final clarification output).

FINAL CLARIFICATION OUTPUT									
Day N°1		**Day N°2**		**Day N°3**		**Day N°4**		**Day N°5**	
COD mg/ 130	COD mg/ 36	COD mg/ 162	COD mg/ 44	COD mg/ 153	COD mg/ 28	COD mg/ 160	COD mg/ 32	COD mg/ 167	COD mg/ 39

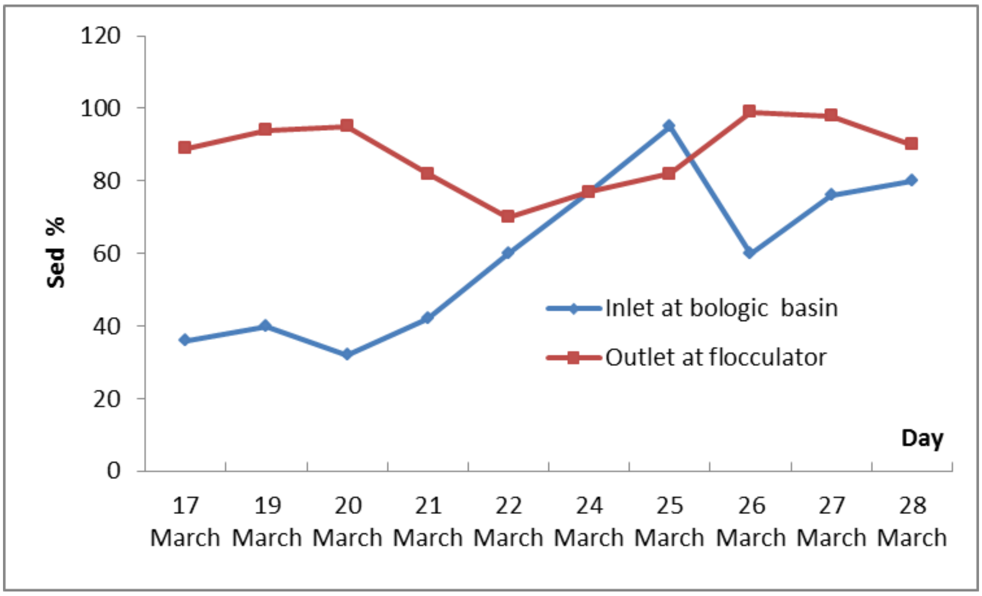

Figure 12. Daily variation in the sedimentation of the sludge at the outlet of the WWTP flocculator.

DOI: https://doi.org/10.17509/ijost.v6i2.34545 |
p- ISSN 2528-1410 e- ISSN 2527-8045 |

4.CONCLUSION

The monitoring of the pollution parameters carried out on the purified wastewater of the Sebdou textile complex showed significant variations in certain parameters. However, others show only small fluctuations.

- The average value of the temperature of the wastewater is of the order of 25 ° C with an average of 22 ° C at the outlet, so it complies with Algerian standards.
- The pH values of the purified water are between 7 and 7.5 with an average of 7.43, so it complies with the Algerian discharge standards (pH 6.5 to 8.5).
- BOD5, its values are between 28 and 44 mg / l in treated water, with an average of 36.5 mg / l. So it is not in accordance with the Algerian discharge standards (30 - 40 mg / l).
- The COD values vary between 100 and 200 mg / l at the outlet of the WWTP, showing the efficiency of the latter in terms of water pollution control in accordance with Algerian discharge standards (250 mg / l).
- The mean value of the SS is 36.2 mg / l and it is satisfactory compared to the value of the Algerian discharge standards which is 30 to 40 mg / l.

In addition, according to the analyzed parameters of the treated water of the sewage treatment plant of the Sebdou textile complex, it should be noted that they all comply with the discharge standards and according to the results obtained we confirm the proper functioning of this station. purification, which will undoubtedly help to preserve the receiving environment (Oued Tafna) from the pollution generated by this plant.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the data and the paper are free from plagiarism.

6. REFERENCES

Behera, B., Rahut, D., B., and Sethi, N. (2020). Analysis of household access to drinking water, sanitation, and waste disposal services in urban areas of Nepal. *Utilities Policy*, *62*(2020), 100996.

Belbahloul, M., Abdeljalil, Z., and Abdellah, A. (2014). Comparison of the efficacy of two bioflocculants in water treatment. *International Journal of Scientific Engineering and Technology*. *3*(6), 734-737.

Bencheikh, I, Azoulay, K., Mabrouki, J., Hajjaji, S. E., Moufti, A., and Labjar, N. (2021). The use and the performance of chemically treated artichoke leaves for textile industrial effluents treatment. *Chemical Data Collections*, *31*(2021), 100597.

Heba, A., Eman, S. M. (2020). Co-sensitization of mesoporous ZnS with CdS and polyaniline for efficient photocatalytic degradation of anionic and cationic dyes. *Colloid and Interface Science Communications, 39*(2020), 100330.

Khechekhouche, A., Benhaoua, B., Driss, Z., Attia, M. E. H., and Manokar, M. (2020 A). polluted groundwater treatment in southeastern algeria by solar distillation. *Algerian Journal of Environmental and Sciences*, *6*(1).1207-1211.

DOI: https://doi.org/10.17509/ijost.v6i2.34545
p- ISSN 2528-1410 e- ISSN 2527-8045

Khechekhouche, A., Benhaoua, B., Manokar, M., Sathyamurthy, R., and Driss, Z. (2020). Sand dunes effect on the productivity of a single slope solar distiller. *Heat and Mass Transfer*, *56*(4), 1117-1126.

Khechekhouche, A., Bouchmel, F., Kaddour, Z., Salim, K., and Miloudi, A. (2020 C). Performance of a wastewater treatment plant in south-eastern Algeria. *International Journal of Energetica*, *5*(2), 47-51.

Kim, Y. K., Yoo, K., Kim, M. S., Han, I., Lee, M., Kang, B. R., and Park, J. (2019). The capacity of wastewater treatment plants drives bacterial community structure and its assembly. *Scientific Reports*, *9*(1), 1-9.

Nguyen, T. A., and Juang, R. S. (2013). Treatment of waters and wastewaters containing sulfur dyes: a review. *Chemical Engineering Journal*, *219*(2013), 109-117.

Shammas, N.K., Yang, J.Y., Yuan, P.C., and Hung Y.T. (2005). Chemical Oxidation. Physicochemical Treatment Processes*. Handbook of Environmental Engineering*, *3*(2005), 229-230.

Suschka, J., and Ferreira, E. (1986). Activated sludge respirometric measurements. *Water Research*, *20*(2), 137-144.

Weinberg, H.S., Pereira, V.R.P.J., Philip Singer, C., and Savitz, D.A. (2006). Considerations for improving the accuracy of exposure to disinfection by-products by ingestion in epidemiologic studies. *Science of Total Environment*, *354*(1), 35-42.

Westall, F., and Brack, A. (2018). The importance of water for life. *Space Science Reviews*, 214(50), 1-23.

Yahiaoui, K., Ouakouak. A., Guerrouf. N., Zoubeidi. A., and Hamdi, N. (2020). Domestic wastewater treatment by vertical-flow filter grown with juncus maritimus in arid region, *International Journal of Engineering Research in Africa*, *47*(2020), 109–17.