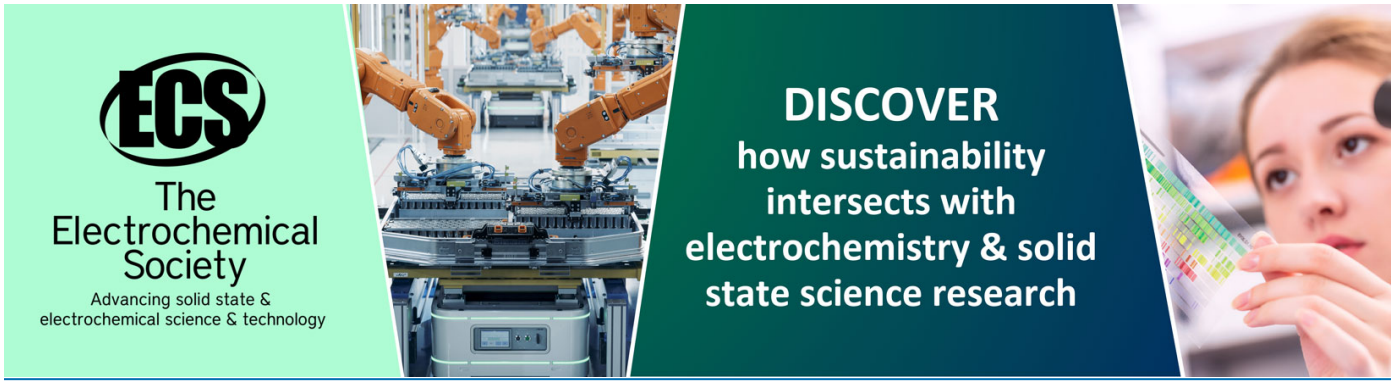
Evaluating the Efficiency of some Wastewater Treatment Plants in Najaf Governorate



IOP Conf. Ser.: Mater. Sci. Eng. **1145** (2021) 012172 https://doi.org/10.1088/1757-899X/1145/1/012172

Retraction

Retraction: Evaluating the Efficiency of some Wastewater Treatment Plants in Najaf Governorate (*IOP Conf. Ser.: Mater. Sci. Eng.* **1145** 012053)

Published 23 February 2022

This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

Retraction published: 23 February 2022

Evaluating the Efficiency of some Wastewater Treatment Plants in Najaf Governorate

Rana Hassan Naji[1], Basim H. Khudair Al-Obaidi[2], Mohammed Sadeq Salman[3]

[1]M.Sc. student College of Engineering-University of Baghdad, Baghdad, Iraq.
[2]Assistant Professor in college of Engineering-University of Baghdad, Baghdad, Iraq.
[3]Assistant Professor in College of Environmental Engineering of Baghdad, Baghdad, Iraq
r.naji1901m@coeng.uobaghdad.edu.iq[1]

Abstract. Although there are many wastewater treatment plants, we still suffer from many problems resulting from a lack of experience or technical operating problems. In this research, the service's efficiency is evaluated according to the design laws required for small factories in the province of Najaf, which works with filtering technology through point filtration, the old project in the Al-Baraka plant, and the second works. Within the biological treatment mbbr + activated sludge, which is a biomass technology where samples were taken from both plants and annual values of the pollutant rate after treatment in the old Al-Baraka plant project COD 64 mg /L and the demand for biochemical oxygen (79) mg /L, the total suspended matter TSS 60 mg / L, PO4 phosphate 2.67 mg / L, NH3 11.46 mg / L, while Turbo 4 BIO results were as follows: 15 mg / L and 28, 83 mg / L, 2.6 mg / L and 6.173 mg / L each who are they. BOD, COD, TSS, PO4, and NH3 respectively, the results were the removal efficiency of the old brake project as follows: BOD 78%, COD 60%, TSS 60, PO4 63% compared to the Bio- Shaft project, the removal is done as follows: BOD8 9%, TSS, COD 60% PO4 60%, NH3 53%. Through the previous results, we conclude that the outputs of both stations are within the standards and permissible limits of the Iraqi specifications, but the Turbo 4Bio plant showed higher efficiency in terms of removal, and the reason may be that the old project needs periodic maintenance

Keywords: Station performance evaluation, Mbbr, trickling flitter

1. Introduction

The increasing rate of urban and industrial population growth that our planet has faced over the past 100 years has resulted in a remarkable increase in environmental pollution that has negatively affected the quality of water, air, and soil. In this context, wastewater treatment has become one of the most important environmental issues as long as it reduces natural water sources' pollution only [1,2]. The results of water quality analysis refer to sanitation and groundwater networks with sewage and industrial water; However, many cities and towns are healthy. There is still a great shortage in the number of treatment plants and the lack of performance, operation, and optimal investment for existing projects. These are among the most prominent challenges and problems faced by the sector. Sanitation in Iraq [3] The efficiency of the

wastewater treatment plant is closely related to the efficiency of the treatment units, evidenced by the specifications of the water subjected to treatment in these units, hence the importance of the monitoring process [4].

Secondary treatment is carried out with biological membranes using natural ventilation of biological filters (intermittent filters). While the biological filters are in operation, the bacteria on the heavy water contaminants remain fixed in the filter package. It will likely cause air to flow to the fillings. This phenomenon appears in the filter layers, and this phenomenon is called (exfoliation). Note, the effect of hypoxia is usually due a few hours before this happens, with no losses in biological cells, while bacterial growth produces the largest number of bacteria, the fastest, and the droppers (food). Real estate bacterial biomass by vibration, either as agglomerates or sludge after sedimentation tank. The original filters do not clean well and have a high reception from the primary tank, mould dimensions in sedimentation, and removal effectiveness (BOD). And they are obtaining a result of pneumatic causes, which may lead to problems related to the performance of the filter and the service life of high-ranking filters if good humidification is a sign of the sufficient flow rate that passes through the filter housing. The filter gaskets require an ideal wetting rate (1.2 - 1.6 m3 / m2) for the flat area of the filter per hour, and the initial design to maintain this required ratio is a continuous circulation system that uses two rotating pumps.

The wastewater treatment plant project was implemented in (2011) by the Lebanese company (F&B) and through the American treatment system (BIOSHAFT TURBO REACTOR). It was commissioned in (2014) by the company, and the Sanitation Directorate operated the Najaf project. 2015) includes physical and biological treatment as well as final sedimentation and sterilization processes. The plant's highest design flow rate is (50,000 m3 / day), and the final flow characteristics are 10 mg / L of BOD, 10 mg / L of TSS, and 40 mg / L of (COD). The wastewater is first pumped to the primary treatment (physical treatment) via a conveyor line connected to the main pumping station of the project, which receives water from the pumping stations located in the neighbourhoods of Kufa connected to the network and the conveyor. Lines of the city of Kufa. Primary treatment is done by screening heavy water (wastewater) to remove large objects and suspended metals that may cause a breakdown of the rotating equipment. Sand and oils are removed by equipment and sinks to remove sand and oils. The sifted water enters the two-trough aeration basins. The suspended bacterial agglomeration grows to analyze and process organic matter (BOD), (COD), ammonia, and phosphates. Then, the water is conveyed to the bio shaft ponds to be further treated, and the treated water is transported to the final sedimentation ponds. So that the sludge is deposited and returned to the aeration basin fully and continuously, and the treated water is conveyed to the chlorine mixing channel, then it is left in the river via the transmission line, with a diameter of 1 meter and a length of 600 meters of its advantage for an elegantly simple BioShaft system. Less than (1) one kilogram per kilogram of BOD is required compared to a minimum (2.5) kilograms of oxygen required for conventional systems. The Bio-Shaft system nearly eliminates the production of sludge and uses minimal electromechanical components among its applications. Bio-Shaft USA 41571 Corning Place # 106 Morita, California 92562, USA [5]. Herein lies the importance of this research in finding the two plants' treatment efficiency by conducting laboratory measurements and analySIS for several indicators: COD, BOD, TSS, PO4, NH3, and evaluating the final flow quality according to the Iraqi standard design specifications.

2. Materials and Methods

2.1 Case Study discerption: Al-Barakia area, which contains two wastewater treatment plants, is located in Najaf, southeast of Kufa Governorate, on the Euphrates River (Shatt al-Kufa) on the coordinates (N 44 25 11, 40 00 32) "in Form No. 1 to (Palmer, 2004) which Located 175 km south of Baghdad, the first station of the old Al-Barakia project serves an area of 50 thousand square meters represented in the

districts of Kufa, Maysan, Saad, and Wafa July 17 Canada, the university and other neighbourhoods of Najaf, where the old project works with a flow of 28 thousand cubic meters per day. The Bio Shift project for heavy water treatment in Kufa serves 100% of the population. [6-10] The water treatment project in Kufa is designed to receive 200,000 inhabitants, and the final runoff characteristics are 10 mg / L of BOD, 10 mg / L of (TSS), and 40 mg / L of (COD). Sewage treatment plant project The project was implemented in (2011) by the Lebanese company (F&B), a second by the American System for Treatment (BIOSHAFT TURBO REACTOR)) and it was commissioned in (2014) by the company and the Sewerage Directorate In Najaf operated the project. 2015) includes physical and biological treatment as well as final sedimentation and sterilization processes in figure 1. The highest design flow rate for the station (50,000 m3 / day).

Figure 1. Albarakia WWTP within Najaf map.

The Old Al Braqia Project: The factory is a diagonal filter that serves about 140,000 people with a design capacity of 28,000 m3 / day and consists of the following facilities as shown in Figure 2, which is located after the main gate where there are two channels, each of which contains two types of rough and soft screens that are designed to prevent the entry of particles To the following parts of the plant to prevent damage and blockage. The next unit is the gravel chamber used to remove sand and gravel from the wastewater by gravity. Its purpose is to protect the later parts from clogging and reduce the load on sedimentation basins.

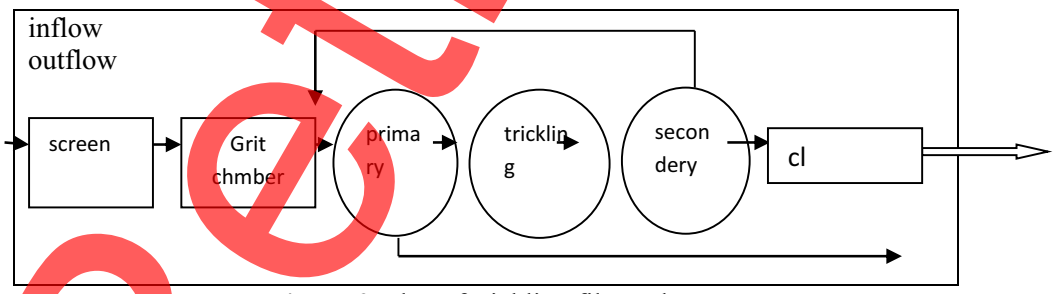


Figure 2. plan of trickling filter plant

Primary sedimentation tanks (PST) represent the pretreatment stage. In these units, the sludge is precipitated, separated from the wastewater, and then drawn from these ponds to other treatment units. The pool water treatment plant contains two rotating hydraulic maximum PST stations. The loading is 45m3 / m2 today, and each tank is 31.6m in diameter, and the first secondary treatment unit is a biological drip filter (TF). It represents the most important part of the plant. It is responsible for removing dissolved organic matter by microorganisms that form biofilm on the packing material surfaces in TF. There 4 treatment units assembled in the Barqa water treatment plant with a maximum organic load of 1 kg BOD /

m3, and the area of each filter is 908 m 2. [11] The next unit of secondary treatment is a secondary sedimentation tank (SST). In this unit, activated sludge from biofilm formation settles in the sediments. Activated sludge is returned to primary sedimentation basins to increase removal efficiency. The factory contains 2 muddy glasses of water, each with a diameter of 31.6m. Also, the plant contains a chlorination unit as well as a processing line for the resulting sludge.

Bio-shaft station: The bio-shaft is designed to accommodate and treat wastewater of approximately 50,000 m3 / day, as shown in Figure 2. Filters represent the first treatment unit in the plant: Two types of screens: coarse and fine, are intended to protect other parts of the plant from floating particles and large particles. These screens are cleaned manually and automatically. There is a 19 * 6 * 4 rectangular tank, which is a particle oil removal unit. This plant's biological treatment unit is the aeration tank, whose dimensions are (84.5 * 21.6 * 5.7). It includes a blower to pump air into the tank to provide the oxygen that the microorganisms need to complete the treatment and provide the appropriate process. The mixing process inside the aeration tank comes after the second stage of biological treatment inside a turbo 4 Bio, consisting of 16 basins after one (5 * 5 * 7) m3 inside four cylindrical edges with a diameter of 2.4 m and a height of 6 m. Thus, separating the sludge from the liquid in Secondary sedimentation of the tank, in which the filtration process is carried out using the principle of gravity, and the rectangle has dimensions of one (10.8 * 8 * 7.625) meters. All sludge is returned to the aeration tank to increase processing efficiency in figure 3

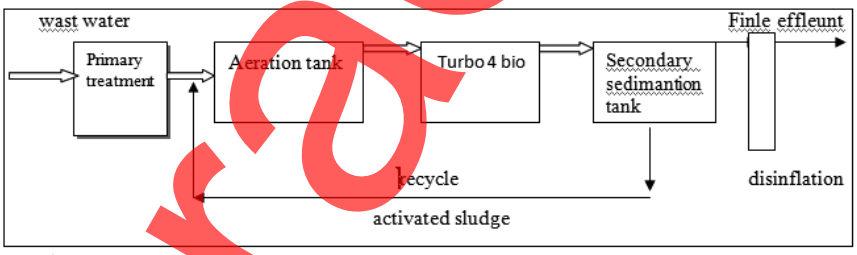


Figure 3. plane Bio-Shaft Station

2.2 Data collection

The data used in this research were obtained from the Sanitation Project's field laboratory in Najaf, Administration / Ministry of Municipalities and Public Works of Iraq. It includes monthly exams for two years from 2018 to 2020 and was working within the standard specifications from December 2018 to December 2020. The Excel program was used for data analysis**.**

3. Bio -shift concept

contains plastic media. It is a suitable environment for aerobic bacteria growth, as the bio-basin contains inside a tube made of iron material, where the wastewater returning from the aeration basins from the top enters the saccharin fraction inside the container. The accompanying bacteria can grow and form a homogeneous saturated biomass layer, acting as an enzyme plant for digesting sludge in a conventional but more compact equilibrium tank, where 98% of the suspended growth is removed, by system unique design features with the self-cleaning capability of T4b-Turbo Reactor. The design of the turbine reactor and the T4b bio-carrier makes the biosphere of air develop and go deep into the media, and the non-oxidative bio-films grow. It allows a group of heterocyclic microbes to remove organic matter and nitrogen. Nitrification occurs by the autotrophic bacteria in the layer attached to the tank wall and gentrification by the heterotrophic bacteria on the oxygen layer simultaneously. MBBR, IFAS or HYBAS,

RBBR IFAS, and MBBR processes use the same proven bio-film conveyor technology used in all MBBR systems, but the conventional activated sludge process. This mixture is known as IFAS static sludge, or HYBAS activated sludge, maintains a mixed liquid suspension on the top Of MLSS solids from single-pass MBBR processes and improved municipal wastewater treatment facilities, and the result is a hybrid process of activated sludge and membrane conveyor technology. Bio-degradation, which achieves a biodegradation performance not comparable to conventional activated sludge systems of similar size, and MLSS equivalent MBBR 6000 to 10,000 mg / l, so the MBBR process is half or one-third of the activated sludge containing the yield RBBR is the yield biomass reactor where The established growth process, which is only 100%, is non-sludge. Instead, it is due to aeration tanks. The output is zero because the FT bio-system is better than the hybrid CAS used in the all-around competition, including MBR and MBBR, such as energy-saving, odour, and sludge.

The equations for making those calculation areas flowing:

1)BOD loading rate =Q*So*8.34*453.59 …… (1)
Q is the wastewater flow rate MBBR rector in MGD
So: is BOD concentration is that in effluent flow mg/L
BOD loading rate is in g/day

2)**require surf. area =BOD loading rate is g/day ……(2)**
SALE: is the design surface area loading rate in g/m²/day the calculated required carrier surface area will be in m²

3) **required carrier volume = required carrier surf. Area/carrier-specific required carrier surface area (3)**
Carrier specific area is in m²/m³ the calculated required carrier volume will be in m³

4)**required tank volume = required carrier volume /carrier fill%.....(4)**
where: required tank volume will be in the same units as required carrier volume
5) **liquid volume in tank = required tank volume – [required carrier volume(1 – carrier % void space)]……..(5)**

Where: all three volumes will be in the same units. Note that volumes calculated in m³ can be converted to ft3 by multiplying by 3.28083 ft3/m3. Although hydraulic retention time (HRT) is not typically used as a primary design parameter for MBBR reactors, it can be calculated at the design wastewater flow rate if the tank's liquid volume is known. Also, if a design peak hour factor is specified, then the HRT at peak hourly flow can be calculated. The equations for calculating HRT are as follows:

Ave. HRTdes ave = liquid vol. in the tank*7.48)/[Q*106/(24*60)]……..(6)
where: liquid vol. in the tank is in ft3 Q is in MGD 7.48, the conversion factor for ft3 to gal 106 is the conversion factor for MG to gal 24*60 is the conversion factor for days to min Ave. HRTdes ave will be in min

2. Ave. HRTpeak hr = Ave. HRTdes ave/Peak Hour Factor ……(7)
where: Ave. HRT peak hr will also be in min**[12]**

4. Results and Discussion

4.1. Raw Sewage Assessment: The characteristics of the raw wastewater affecting the two plants are the

same as the wastewater effluent properties stored in the main pumping station. The BOD entering the baraka station is stable and variable except in a few percentages. The highest value is in April 2019 (200 mg/litre), while the highest value for COD, according to Figure (3) 475 mg/litre in October 2019, in addition to TSS, The highest value in 2019 was 424mg. / L and this indicates that in 2019 there was a higher organic load than in 2018. If we look at the Figure 4 of the bio-shaft plant, we also note the values of the concentrations in general during the two years. They differ only in small proportions, and the highest BOD value in October In 2019, which is 190mg / L in 2019, while the highest COD value was 320 mg / L and the lowest value is 120mg / L in September 2018, we conclude from the above that the year 2019 is subjected to organic loading at high concentrations and higher than previous years due to tourism or commercial conditions. It is no secret that the city of Najaf is a tourist city, and many visitors come to it, and all this increases the organic loading of the concentrations that enter the station.

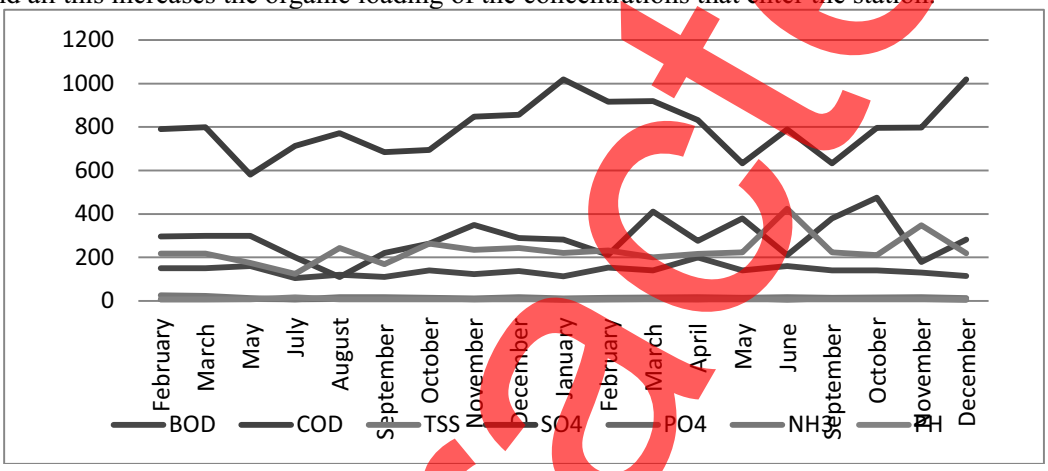


Figure 4. The influential variation of pollutant concentrations with the years 2018-2019 of Al Barakia Station

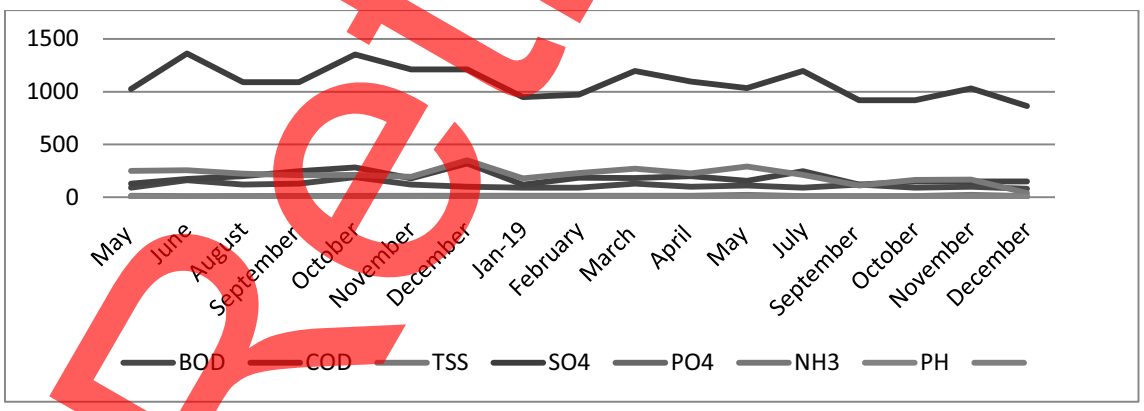


Figure 5. The influential variation of pollutant concentrations with the years 2018-2019 of Bio-shaft Station

The BOD / COD ratio is one of the important indicators. It means the ability to biodegrade and healthily complete the biological process and get rid of pollutants, where if the ratio is between 0.5-0.8, it is good.

The possibility of decomposition is within normal conditions. The process under special conditions such as high temperature, where the treatment output is ineffective, notice that the ratio appeared to us in the Brakia station is 0.41. This value falls in the range of 0.3 - 0.8, as mentioned in Metcalf M and Eddy, 2014). This value is lower than compared to the effective BOD / COD ratio verified by (Al-Sulaiman W. Khudair, 2018), which was 0.49. The maximum value was 0.5, which is the minimum of 0.32, and this difference may be related to the characteristics of the wastewater and the amount of the organic degradable. The ratio in the bio-shaft station, 0.63, meaning it is between 0.5-0.8, biodegradation will occur easily. It was found that household wastewater usually contains a BOD / COD ratio between 0.4 and 0.8. In this study, the ratio was BOD / COD. The crude effect is about 0.46, which indicates a large amount of organic matter subjected to biodegradation. The average percentage during the year was 0.63 and it is considered strong decomposition, and there is no toxicity the biological process is good.

4.2. Assessment for Effluent COD: In the Figure, the values of the concentrations after treatment in the Barakia station were within constant rates, and there is no fluctuation, and this indicates a stable performance of the plant except for the concentration of SO4, which appeared with high values, as the highest BOD value was 52.5 mg / L in December 2019 and the lowest value was 18.75 mg / L In 2019 the highest COD value was 180 mg / L in September 2019, while the TSS value was at constant rates, with the highest value in 2018 being March 148 mg / L. These results are generally good and within the permissible limits, and if we look at the Figure (5) in which the results of the Bio Shaft plant appeared, the highest BOD value was 35 mg / L in 2018 in September, and the lowest value was 15 mg / L in several months. The Bio-Shaft plant results showed lower results than the results of the Al Baraqia plant after treatment, which means that the efficiency was better. The possibility of reaching the lowest values of pollutants and obtaining a very good treatment and the highest COD value was also in September 2019, of 194 mg / l, we can conclude From the above results. In September, the values were high**.**

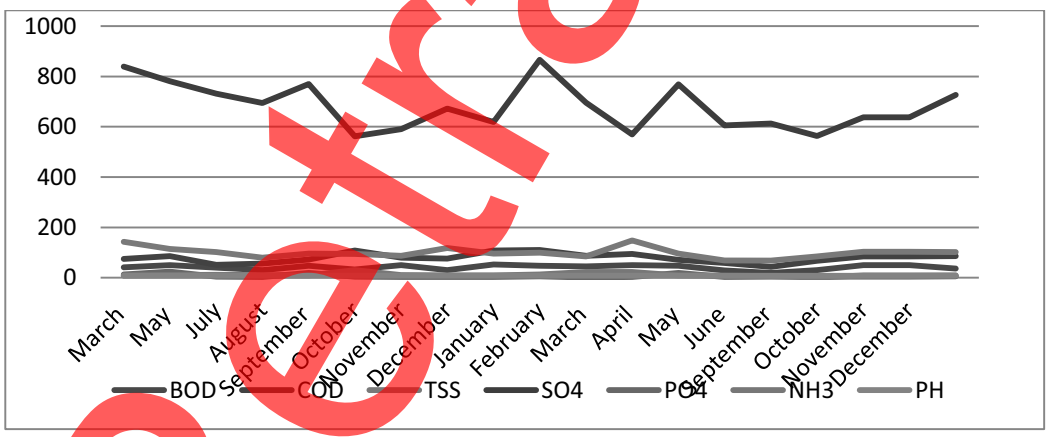


Figure 6. The effluential variation of pollutant concentrations with the years 2018-2019 of Al Barakia Station

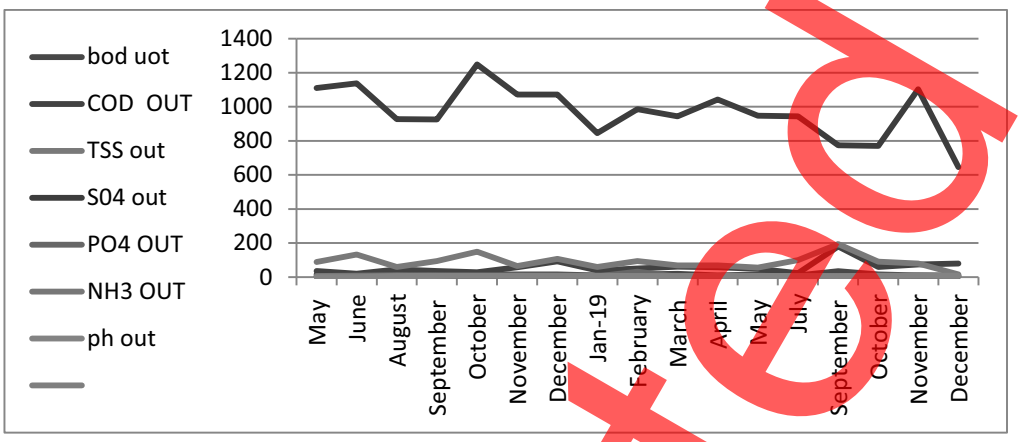


Figure 7. The effluential variation of pollutant concentrations with the years 2018-2019 of Bio-shaft Station

Removal efficiency (RE): One of the most important criteria that can be used to measure selective bioreactors' performance in wastewater or water treatment is. There are several types of efficiency components: BOD, COD, N, and TSS. RE is calculated using Equation 1

$$RF = (IN\ F\text{-}EFF) / INF.*100$$

The mean removal efficiency of 2 years for BOD, COD, and TSS was (89, 78, and 60)% for the biomass plant, which are good results for both the brake plant. Figure 6 and 7 shows the removal efficiency of BOD, COD, and TSS being (78,60,60)% over the years (2018-2019). The microbes then repair in the plant, but in general, the microorganisms do not perform well due to the lack of oxygen transported in the trickle filters (Metcalf and Eddy, 2014) where some modifications have been made to the station, such as changing the media, adding scavengers and some other facilities with British expertise**.**

5. Conclusions

1) At Al-Barakia station, the results for all concentrations were within the permissible limits. The rate was within the two-year range (41, 75,142,839, 12.3,10.3,7.3) mg / L each of BOD, COD, TSS, SO4, PO4, NH3, PH) on Straight and the results of the bio-Shaft plant were for the concentrations after treatment (15, 58, 89, 971, 5. 6, 8. 7.5) mg / L each of BOD, COD TSS, SO4 PO4 NH3.
2) The removal efficiency rate for BOD and COD TSS respectively was (78, 60 and 60)%, compared with the removal efficiency rates for bio-shafts are lower. The reason is that the Al Barakia station works under old technology and is within the age of extinction. However, its rehabilitation by specialized companies and the organic load is high entering the plant, which is greater than the design capacity. The bio-shaft's removal efficiency is (89, 78, 60)% for BOD, COD, and TSS, respectively. Also, the bio-shaft technology is distinguished by being environmentally friendly as it does not produce sludge at all.
3) The ratio of BOD / COD in the Bio-shaft plant is 0.63 because the decomposition and normalization process is normal. The treated water does not contain toxicity, while the Al Barakia plant ratio was 0.41, and it is considered ineffective. Decomposition is slow and does not happen easily.

The authors would like to thank the Najaf Sewage Directorate and the Al-Barakia Sewage Treatment Plant to obtain data and provide facilities to communicate with the plant manager and laboratory staff. The

authors thank the Sanitary Engineering Laboratory and Civil Engineering Department / College of Engineering - the University of Baghdad for their valuable support in completing this work.

References

[1] ALSINA, F.X.; Gallego, A. Figo, c. Roda, I., R. Multipurpose evaluation of control alternatives in wastewater treatment plants. Journal of Environmental Management, Vol. 91, 2010), pp. 1193-1201.
[2] Turkoman, Abd Al-Razzaq Muhammad Saeed. National Health Education Bulletin - Education Treatment plants - Absent national strategy and a waste of money Syria (3111), April 03, 2013.
[3] The State Planning Commission - the tenth five-year plan. Drinking-Water and Sanitation Sector - Chapter 15. Syria, p. 32.
[4] WHO Regional Office for the Eastern Mediterranean. Training lectures for water treatment plant operators Craps. Primary Center, Recreation Environment, 332, 3114
[5] https://bioshaft.com/.
[6] Al- Saeed R. Tomaleh, N. Extended Performance Appraisal to Full-Scale Ventilation System in Al-Bireh. Palestine, Clean Soil, Air, and Water, Volume 1 (2012), P1-7.
[7] Colmenarejo, FM; Rubio, A. Sanchez, E. VicentE, J.; Garcia, General Motors; Borga, R. Evaluation of various municipal wastewater treatment plants technologies Las Rozas, Madrid (Spain). Journal of Environmental Management, Volume 81, (2006), pp. 399-404.
[8] Haldorai and A. Ramu, An Intelligent-Based Wavelet Classifier for Accurate Prediction of Breast Cancer, Intelligent Multidimensional Data and Image Processing, pp. 306–319.
[9] S, D., & H, A. (2019). AODV Route Discovery and Route Maintenance in MANETs. 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS). doi:10.1109/icaccs.2019.8728456
[10] H. Anandakumar and K. Umamaheswari, An Efficient Optimized Handover in Cognitive Radio Networks using Cooperative Spectrum Sensing, Intelligent Automation & Soft Computing, pp. 1–8, Sep. 2017. doi:10.1080/10798587.2017.1364931.
[11] Henze, M., Loosdrecht, M., and Ekama, G. (2008). Biological Wastewater Treatment; Principles, Modelling, and Design.
[12] Harlan H. Bengtson, PhD, PE Continuing Education and Development, Inc. 9 Greyridge Farm Court Stony Point, NY 10980