Evaluating the Water Treatment Efficiency of the Plant Sewage in the Tuz Khurmatu District

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Abstract

The research includes a study of evaluating the treatment efficiency of the sewage plant in the Tuz Khurmatu district during the period from September 2020 to July 2021. Three study sites have been selected. The study includes measuring certain physicochemical and biological properties of water (the biological properties include studying the quality of algae). As for the physicochemical properties, they include measuring (air and water temperature, pH, dissolved oxygen, biological oxygen requirement (BOD_5), active phosphate and active silicates).

The results found that air temperature ranges between 12- 49°C, while the water temperature ranges between 9- 40°C. The pH values have a wide range during the months of the study ranging between 6.20 - 8.45. The values of the dissolved oxygen range between 1.25-3.10 mg/L, and the values of the biological requirement for oxygen range between 19.2- 47.2mg/L. The study also shows that the wastewater during the study period is of a light basicity in which bicarbonate ions prevail. Nutrient concentrations fluctuate depending on the nature of the site and the date of sample collection, as the effective phosphate ranges between 2.32-7.76 mg phosphorous-phosphate/liter. As for the silicate values, they range between 0.38- 6.61 mg atom of silicon - silica / liter.

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As for the biological study of the type of algae, four phyla, four class, nine orders, ten families and fourteen genus are diagnosed. Algae belonging to the class *Diatoms* are the dominant among the studied taxa, which belong to the genus *Cyclotella, Caloneis, Navicula, Nitizchia* and *Cymbella*. As for Green algae they are of the genus *Scenedesmus dimorphus, Closterium moniliferum,* and *Microspora, Cosmarium,* while for the Blue-green algae they are *Chroococcus, Nostoc, Spirulina laxissima, Oscillatoria,* and for the Euglena algae they are of the genus *Euglena*. Seasonal variations in the numbers of phytoplankton are also observed during the current study. The results of the statistical analysis using the analysis of variance show that there are significant temporal differences for all factors (at the level of significance $p \geq 0.05$), and there are significant local differences except for air and water temperature and the vital requirement for oxygen.

Key words: Dissolved oxygen, bicarbonate, nutrient, diatoms.

تقييم كفاءة معالجة مياه محطة الصرف الصحي في قضاء طوزخورماتو

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الخلاصة

تضمن البحث دراسة تقييم كفاءة معالجة محطة الصرف الصحي في قضاء طوزخورماتو خلال الفترة من شهر أيلول 2020 ولغاية شهر تموز 2021 وتم تحديد ثلاث مواقع للدراسة على طول المحطة. شملت الدراسة قياس بعض الخصائص الفيزوكيميائية والحيوية للمياه، شملت الخصائص الحيوية دراسة نوعية الطحالب. أما الخصائص الفيزوكيميائية فتضمنت قياس (درجة حرارة الهواء والماء، الأس الهيدروجيني، الأوكسجين الذائب، المتطلب الحيوي للأوكسجين (BOD_5). والمغذيات النباتية الفوسفات الفعالة والسليكات الفعالة). ومن النتائج تبين أنَّ درجة حرارة الهواء تراوحت بين (12- 49)°م، في حين تراوحت درجة حرارة الماء بين (9- 40)°م، وجاءت قيم الاس الهيدروجيني ذات مدى واسع خلال أشهر الدراسة إذ تراوحت بين (6.20-8.45) وسجل الأوكسجين الذائب قيماً تراوحت بين (1.25-3.10) ملغم / لتر أما قيم ألمتطلب الحيوي للأوكسجين فقد تراوحت بين (19.2-47.2) ملغم / لتر وأظهرت الدراسة أنَّ مياه الصرف خلال فترة الدراسة

كانت ذات قاعدية خفيفة سادت فيها أيونات البيكاربونات. وتذبذبت تراكيز المغذيات اعتماداً على طبيعة الموقع وتاريخ جمع العينات اذ تراوحت الفوسفات الفعالة ما بين (2.32-7.76) ملغم فوسفور- فوسفات /لتر. اما قيم السليكات فقد تراوحت بين(0.38-6.61) ملغم ذرة سليكون- سليكا /لتر.

أما الدراسة الاحيائية لنوعية الطحالب تم تشخيص (4) شعب و(4) أصناف و(9) رتب و(10) عوائل و(14) جنس, الطحالب التي تعود الى صنف الدايتومات هي السائدة بين الأصناف المدروسة والتي تعود الى الأجناس *Cyclotella*, *Caloneis*، *Navicula* ، *Nitizchia*، *Cymbella*، ومن الطحالب الخضراء *Scenedesmus dimorphus* ، *Closterium moniliferum*، *Microspora* ، *Cosmarium* ، ومن الطحالب الخضر المزرقة ، *Chroococcus*، *Nostoc*، *Spirulina laxissima* ، *Oscillatoria* ، ومن الطحالب اليوغلينية جنس *Euglena* . وقد لوحظ وجود تغايرات فصلية في أعداد الهائمات النباتية خلال الدراسة الحالية.أظهرت نتائج التحليل الاحصائي باستخدام تحليل التباين وجود فروق معنوية زمانية لجميع العوامل (عند مستوى معنوية $p \geq 0.05$) ووجود فروق معنوية موقعيه عدا درجة حرارة الهواء والماء والمتطلب الحيوي للأوكسجين.

الكلمات المفتاحية: الأوكسجين الذائب، البيكاربونات، المغذيات، الدايتومات.

Introduction

The pollution of the aquatic environment is regarded as one of the major problems that concern governments and peoples all over the world that are striving to solve these problems, as the continuation of this pollution is enough to cause severe damage to human health, environmental systems and civilizational development [1].

Water has the ability to purify itself of pollutants by environmental factors if the dumped pollutants are within the bearing capacity of the water body, and due to the high concentrations of the flows, it has become difficult for the water to purify itself [2]. Because of human behavior and daily activities there is the dumping of large quantities of water that is not suitable for human consumption. In order to get rid of this water, sewage networks are established to collect and treat this water, and to get rid of the components of this water from impurities so as not to decompose the organic materials that contain it, which poses a danger to humans. It is to be noted that most institutions do not have their own processing unit. The water is drained directly to the sewage side of the plant. As for the main treatment plant, its work is limited to the disposal and treatment of organic and suspended materials only. As for the chemical elements released from hospitals and industrial areas, they are not treated inside the main treatment plant and are disposed directly to the trocar [3]. The study and diagnosis of algae is an important and essential indicator in measuring the quality of water, its cleanliness, and its suitability for various uses, and determining the cases of nutrient enrichment that negatively affect water quality and suitability for various purposes in both stagnant and running fresh water systems [4]. It also determines the presence and quality of plant nutrients in that water [5].

The purpose of evaluating the efficiency of the wastewater treatment plant in the Tuz Khurmatu district is to ensure that any proposed activities, programs or development plans are environmentally sound and ensure sustainability and are used to anticipate, analyze and crystallize the important environmental impacts of any proposal and provide data and information that are important in the decision-making stage.

Aims of the Study

1. Studying the physicochemical properties of wastewater in Tuz Khurmatu district to determine the percentage of pollutants in the study sites before and after the treatment.
2. Studying the quantity and quality of algae in a sewage treatment plant in the Tuz Khurmatu district.

General description of the study area

Some qualitative characteristics and monthly changes of the water of the sewage treatment plant in the Tuz Khurmatu district (Al-Jumhuriya neighborhood, Imam Ahmed neighborhood, Al-Askari neighborhood, Al-Surour neighborhood, Al-Siddiq neighborhood) are studied. The water is collected in concrete manholes ranging in depth from 2.5 to 3 meters, and the water is transferred to the treatment plant through concrete pipes (asbestos). The assembly point is in the main station near the drainage channel of the Kirkuk irrigation project, west of the city of

Tuz Khurmatu. The study area is determined within Salah Al-Deen Governorate, which lies between longitudes 44.58-44.26 east and latitude 35.10-34.30 in the north [6] each site is away from the other two kilometers.

The selection of the study sites of Tuz Khurmatu district comes due to the lack of scientific studies and research on wastewater in this area. The treatment of wastewater is of environmental importance in general and for the study area in particular in terms of health, because this wastewater is thrown into the water of the Kirkuk irrigation project, which passes through the western district of Tuz Khurmatu which is used for drinking. The study includes three sites as shown in the figure below.

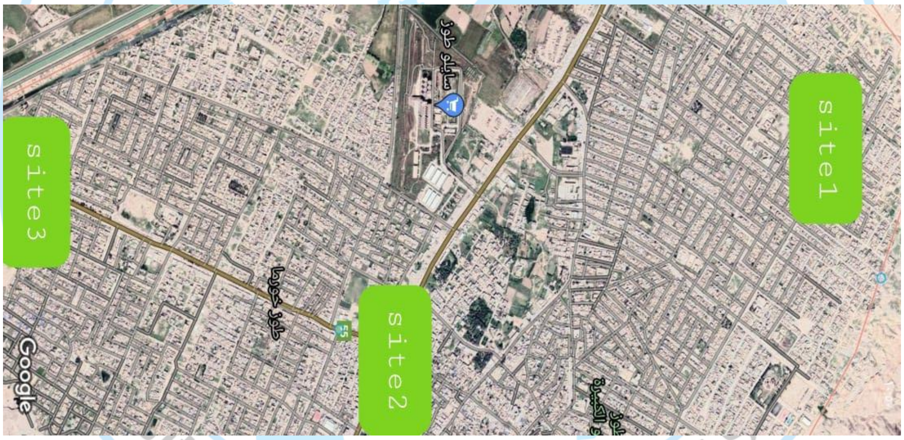

Plate 1: Study sites

Materials & Methods

1- Physical Parameters

Temperature

The air and water temperature in the field is measured in the eleventh morning and using a mercury thermometer with a range of -10 - 100 degrees Celsius and a scale of 1 degree Celsius. The air temperature surrounding the site is measured by placing the thermometer in the shade and at a height of one meter from the ground. It is measured by immersing the mercury-containing end of the thermometer directly in water for about two minutes, until the reading is stable and then recorded.

2- Chemical Parameters

PH

The pH of the samples in the field is measured using a pH meter made by HANNA type (Microprocessor HI 9321) after calibrating the device with standard buffer solutions with a pH of 4, 7, 9.

Dissolved Oxygen

The modified Winkler method was used to determine the concentration of dissolved oxygen in the water. Oxygen bottles with a volume of 250 ml were filled by immersing them in water and making sure that there is no air bubble. The oxygen of the sample in the field is fixed by 2 ml of manganese sulphate, then 2 ml of base potassium iodide was added. The sample is well shaken where it is stirred twice or more, and then left for about 10 minutes and then adding 2 ml of concentrated sulfuric acid, and by this the proportion of oxygen in the water was fixed. In the laboratory, 50 ml was taken from the sample and tittered with sodium thiosulfate of 0.025 to calculate the oxygen concentration with the addition of drops of starch as a reagent and taking a rate of two readings. The results were expressed in the units (mg / liter) method as described in [3].

Biochemical oxygen demand

The same method of dissolved oxygen measuring was used the Biochemical oxygen demand opaque bottles 250 ml were filled for all samples. These opaque bottles were then transferred to the laboratory. After placing the samples in the incubator for five days at a temperature of 25 ° C, the oxygen concentration in these bottles was measured. Using the equation, the Biochemical oxygen demand results were determined by units (mg / liter), depending on the method described in [3].

$$BOD_5 \text{ mg/L} = DO_0 - DO_5$$

Phytonutrients

Reactive Silicate

Depending on the method of the American Society for Testing and Methods [9], the reactive silicate concentration of the samples is determined using a Spectrophotometer type CE1011CECLL at a wavelength of 810 nm. The results are expressed in terms of mg of a silicon atom - silica / liter. By the following steps, the concentration of Silica for samples is identified by taking 50 ml of the samples using plastic beakers, and then adding 1 ml of hydrochloric acid at a concentration of 1: 1 distilled water, mixing well and leaving for a minute, then adding 2 ml of ammonium molybdate solution and mixing well and leaving it for 5-8 minutes. Then, 1.5 ml of oxalic acid is added, mixed well and left for one minute, and finally 2 ml of ascorbic acid is added and the solution is left for 10 minutes, after which measuring starts. Using the following rule, the silicate concentration of the samples is determined.

$$SiO_2 = K \times \frac{\text{ABS. Sample}}{\text{V. Sample}}$$

Where (K) is constant and equal to

$$K = \frac{20}{\text{ABS of standard}}$$

Reactive Phosphate

The effective phosphate is measured based on the method published by [10]. Thus, 100 ml is taken from the sample and 10 ml of the prepared Mixed Reagent is added directly to it, noting that the intensity of the blue color is proportional to the concentration of phosphate. The samples are read after two hours by means of a spectrophotometer at a wavelength of 885 nm. The results are expressed in terms of micrograms of a phosphorous-phosphate atom/liter.

$PO_4 = ABS \times F$

3- Vital Parameters

Field Work

The algae are collected by filling the sample water into sterile 15 ml glass bottles. Upon returning to the laboratory, the samples are examined within 48 hours, and no dyes and stabilizers are used, and the samples are examined using the compound microscope.

Laboratory Work

Identification of non-Diatom algae

Upon arriving at the laboratory, the caps of the bottles are opened and placed in a place with good lighting to be ready for examination. The algae samples are examined using a microscope under high and low powers. The samples are fresh and after clarifying the algae well, some samples are photographed using a camera and the algae genera are identified depending on the source [11].

Identification of Diatoms

Diatomaceous algae are diagnosed by preparing temporary slides and examining them at 40 x power using Olympus type compound microscope. To diagnose diatoms, a drop of the sample is placed in the middle of a glass slide and dried on a hot plate at 70 degrees Celsius and a drop of concentrated nitric acid is added to it to clarify the structures of the diatoms. After the drop dried, the cover of the glass slide containing a drop of Canada balsam is placed on it and left for the next day and then examined. The source relied upon is [12].

Statistical Analysis

Using the SPSS 9th edition statistical program, the results were analyzed statistically according to the tests of ANOVA and the calculation of the correlation coefficient.

Results & Discussion

1- Physical Factors

Air & Water Temperature

Temperature affects the increase in the kinetic energy of the interacting particles, the viscosity of water, the solubility of gases such as oxygen and carbon dioxide, and the activity of microorganisms. Water reduces the amount of dissolved oxygen, which affects the process of self-purification and the emergence of new types of living organisms as a result of the increased speed of reproduction [13].

The results of the current study show clear monthly differences in the air temperature, with the lowest values recorded during January at 12 degrees Celsius in the third site, and the highest during the month of July with 49 degrees Celsius in the first site. These differences are due to what is characterized by the climate of the region There is a clear difference between summer and winter temperatures, night and day, as it is known that Iraq’s climate is characterized by a large disparity in air temperatures and in different seasons of the year. The temperature in summer is greatly reduced and decreases to minimum levels in the winter, with a temperature difference between night and day [14]. The results of studying the water temperature in the study sites show the lowest values during the month of January with 9 degrees Celsius in the second site and the highest during the month of July with 40 degrees Celsius in the first site. The current study agrees with the findings of [15] in his study of evaluating the wastewater treatment plant in Samarra. Water is generally characterized by the fact that the range of variation in its temperature is narrow compared to the air temperature [16] , and this causes significant differences between months for water and air temperature at the level of significance p≥ 0.05, and no significant differences between study sites.

Table 1: Monthly and locational changes of Air Temperature (Degrees Celsius) in the study sites.

Months / Sites	Site 1	Site 2	Site 3	Months rates
September	27	26	26	26.3**b**
November	16	15	14	15**c**
January	13	13	12	12.6**c**
March	21	20	21	20.6**b**
April	24	22	23	23**b**
June	44	45	45	44.6**a**
July	49	48	47	48**a**
Sites rates	27.7**a**	27**a**	26.8**a**	

Similar letters mean that there are no significant differences between them

Table 2: Monthly and locational changes of Water Temperature (Degrees Celsius) in the study sites

Months / Sites	Site 1	Site 2	Site 3	Months rates
September	22	21	20	21**b**
November	14	14	12	13.3**c**
January	11	9	10	10**c**
March	20	18	18	18.6**c**
April	21	20	21	20.6**b**
June	36	38	35	36.3**a**
July	40	39	39	39.3**a**
Sites rates	23.4**a**	22.7**a**	22.1**a**	

2- Chemical Factors

pH

The pH values during the study period ranged between 6.20 -8.45. The lowest values are recorded in the first site during the month of June, and the highest during the month of January in the second site. The results of the statistical analysis using the analysis of variance shows the presence of significant differences in time at the level of significance p≥ 0.05 and localized (at the level of significance p≤ 0.01). The average pH values in this study tend to be low basal, and this change in pH values is due to the high regulatory capacity buffar of hard and alkaline water rich in bicarbonate, which resists the change in pH [17]. The high pH values in the cold seasons are due to the fact that the low temperature increases the dissolution of carbon dioxide in water, forming carbonic acid [18]. As for the low values of pH in the first station, the reason for its low values may be due to the large numbers of bacteria and thus the decomposition of the organic matter, and the release of large quantities of carbon dioxide and hydrogen sulfide gas, knowing that the latter is pneumatically converted to sulfuric acid, which leads to a decrease in the pH [19].

Table 3: Monthly and locational changes of pH in the study sites

Months / Sites	Site 1	Site 2	Site 3	Months rates
September	7.22	7.77	7.54	7.51**b**
November	8.28	8.39	8.21	8.29**a**
January	8	8.45	8.35	8.26**a**
March	7.15	7.59	7.80	7.51**b**
April	7.92	7.32	7.14	7.46**b**
June	6.20	6.66	6.89	6.58**c**
July	6.64	7.32	7.87	7.27**b**
Sites rates	7.34**b**	7.64**a**	7.68**a**	

Dissolved Oxygen

Dissolved oxygen in water is one of the important criteria for evaluating water quality and the degree of its pollution. It is important in the process of self-purification of water that occurs naturally by microorganisms and to prevent the formation of harmful odors [19]. The current results show concentrations ranging between 1.25-3.10 mg / liter, with the highest values of dissolved oxygen in the third site reaching 3.10 mg / liter during the month of January. The third site is located in an area with strong wind movement, open and high density of plankton and aquatic plants [20]. The consumption of dissolved oxygen is a result of the increase in the vital oxygen requirement (BOD_5) by bacteria and other microorganisms that use it in the decomposition of degradable organic materials into their raw materials, and this in turn leads to a very large depletion of dissolved oxygen [21]. Also, sewage waste and its contents of organic materials, as well as washing powders and soaps resulting from household uses rich in phosphates encourage the growth of algae in a dense manner. This is what is called eutrophication, as a result of the increase in the concentration of nitrogen and phosphorous compounds, which results in many damages, such as preventing light from reaching the water, and consequently, the lack of chlorophyll metabolism and then the lack of oxygen [22]. The results of the statistical analysis using the analysis of variance show that there are significant temporal and local differences at the level of significance $p \leq 0.05$ between the study sites.

Table 4: Monthly and locational changes of Dissolved Oxygen (mg / liter) in the study sites

Months / Sites	Site 1	Site 2	Site 3	Months rates
September	2.22	2.30	2.68	2.4**a**
November	2.41	2.62	2.87	2.6**a**
January	2.49	2.19	3.10	2.5**a**
March	1.96	2.13	2	2**ab**
April	1.85	1.92	2.21	1.9**b**
June	1.55	1.75	1.89	1.7**b**
July	1.25	1.33	1.30	1.2**bc**
Sites rates	1.96**bc**	2.03**b**	2.29**a**	

Biological Oxygen Demand

The biological requirement for oxygen is the amount of oxygen used by microorganisms in the analysis of organic materials added to water, which negatively affects the water specifications [23]. The results shown in table 5 indicate that the value of the vital oxygen requirement ranges between 19.2-47.2 mg / liter, with the highest value recorded in the first site in July and the lowest value recorded in the third site in January. The values of the vital oxygen requirement in the summer are due to the rise in temperatures and the flow of organic materials present in the sewage waste, so when it decomposes, it consumes the oxygen dissolved in the water [21], so the values of the vital oxygen requirement are directly proportional to the degree of pollution as well as with the temperature. The results of the statistical analysis using the analysis of variance show that there are temporal significant differences at the level of significance $p \leq 0.05$ and no significant local differences between the study sites.

Table 5: Monthly and locational changes of Biochemical Oxygen Demand (mg / liter) in the study sites

Months / Sites	Site 1	Site 2	Site 3	Months rates
September	35.2	32.76	30.1	32.6**b**
November	37.3	33.8	29.9	33.6**b**
January	20.9	22.5	19.2	20.8**c**
March	30	28.4	29.4	29.2**c**
April	38.8	36.7	34.6	36.7**b**
June	43.6	45.2	42.8	43.8**a**
July	47.2	44.6	43.9	45.2**a**
Sites rates	36.1**a**	34.8**a**	32.8**a**	

Phytonutrients

Reactive Phosphate

Table 6 shows the effective phosphate values in the study sites, as the third site has given the highest concentration of phosphate, reaching 7.76 mg phosphorous-phosphate atom/liter in June, while the second site has given the lowest concentration of 2.32 mg phosphorous-phosphate/ liters in the month of April. The results of the statistical analysis using analysis of variance show the presence of local significant differences at the level of significance $p \leq 0.01$ and the presence of temporal significant differences at the level of significance $p \leq 0.05$ between the study sites. The reason for the increase in phosphate concentration during the warm months can be attributed to the disposal of domestic sewage waste and the phosphate components that these wastes carry in their composition [24]. The high amounts of phosphorous in the water may lead to nutritional enrichment in the aquatic environment and the excessive growth of algae and phytoplankton that limit the growth of other organisms and thus the amount of phosphate in the soil increases if this water is used for irrigation [25]. The compound that living organisms can benefit from, especially plants and phytoplankton, and its decrease in their productivity is called active phosphate, which is characterized by being poorly soluble in water [26].

Table 6: Monthly and locational changes of Phosphate (mg / liter) in the study sites

Months / Sites	Site 1	Site 2	Site 3	Months rates
September	4.32	3.78	2.33	3.47**cd**
November	7.26	5.60	5.40	6.08**b**
January	5.37	3.49	4.21	4.35**c**
March	5.46	4.61	2.93	4.33**c**
April	3.76	2.32	2.54	2.87**d**
June	8.65	6.88	7.76	7.76**a**
July	6.93	7.52	5.86	6.77**b**
Sites rates	5.96**a**	4.88**b**	4.43**b**	

Reactive Silicate

The values of silica in the current study range between 0.38 – 6.61 mg atom-silicon-silica / liter. The highest value is recorded in June in the second site and the lowest value recorded in April in the third site. The results of the statistical analysis shown in table 7 using the analysis of variance, that there are significant local differences between the study sites at the level of significance $p \leq 0.01$ and the presence of significant temporal differences at the level of significance $p \leq 0.05$. The increase in silica values in the second site in the summer and its decrease in the third site in the spring is due to the presence of silica in sewage water, which is one of the natural waters that are consumed by humans, as well as the increase in the analysis of organic materials, especially the structures of diatoms containing silica as a result of high temperatures. The heat in summer and the low value of silica in the spring is due to the activity of diatoms and their consumption of silica that they use in building their bodies [27]. These high concentrations of silica are in agreement with what is indicated by [28] that Iraqi waters are characterized by the presence of high silica, so it is noticeable that diatoms are clearly prevalent.

Table7: Monthly and locational changes of Silica (mg / liter) in the study sites

Months / Sites	Site 1	Site 2	Site 3	Months rates
September	1.43	2.65	1.32	1.8**d**
November	2.57	1.86	1.22	1.8**d**
January	0.96	2.76	3.34	2.35**c**
March	0.89	4.64	3.76	3.09**b**
April	3.32	1.56	0.38	1.75**d**
June	4.48	6.61	3.82	4.97**a**
July	3.54	5.78	5.20	4.84**a**
Sites rates	2.45**b**	3.69**a**	2.72**b**	

3 - Biological Factor

Qualitative Study of Algae

In this study, forty-eight species of algae are identified in the three sites covered by the study. It is found that they belong to four algae phyla, distributed into four classes, nine orders, ten families and fourteen genera as shown in table 8. The studied taxa belong to the genera Cyclotella, Caloneis, Navicula, Nitizchia, Cymbella, and from the green algae Scenedesmus dimorphus, Closterium moniliferum, Microspora, Cosmarium, and from the blue-green algae, Chroococcus, Nostoc, Spirulina laxissima, and Euscillator.

The results of our current study have recorded high concentrations of silica, at a rate of 3.69 milligrams of silicon-silica atom per liter, and these concentrations are sufficient for the growth of diatoms and their dominance over the rest of other phytoplankton. In addition, there is the fact that diatoms are algae that are characterized by their ability to grow and reproduce in a wide range of environmental conditions, due to the connection of this type of algae in the presence of silica in the water, as silica represents about 25-50% of the dry weight of the cells of this type of algae, as it is included in the composition of their structures [29]. Also, diatoms are among the basic groups of algae, which constitute 90-95% of the benthic algae in the aquatic medium, due to their ability to live at different times of the year and their tolerance to different ranges of environmental conditions [30]. The use of blue-green algae, euglenoid algae and some bacillus algae as an indicator of pollution has become a common biological method in many countries of the world [31]. One of the most important genera that recorded a clear appearance is (Oscilatoria, Spirulina). The emergence of this type of algae in the warm seasons is due to its increased competitive ability to take important nutrients such as phosphate and increase its effectiveness in these seasons, or as a result of an increase in organic matter in the sediments [32]. As for the Euglena algae, it is the least recorded species. During the study, one genus is diagnosed, which is Euglena. The Euglena algae have the absolute ability to exist and adapt in areas polluted by industrial waste, and the small presence of Euglena species is found in many local studies, including [16].

Through the current study, it is noted that the species Cyclotella meneghinina recorded dominance for diatomaceous species in all stations and in most months of the study, and this is evidence that the waters of the region are organically polluted [33].

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Table 8: Distribution of the diagnosed Algae during the studied months in the study sites

Diagnosed algae	Site 1			Site 2			Site 3		
	M1	4 M	7 M	M1	4 M	7 M	1 M	4 M	7 M
Kingdom: Monera Division : Cyanophycophyta Class: Cyanophycophycae Order: Chroococales Family: Chroococaceae									
Genus: *Chroococcus sp*					+	+		+	
Order: Oscillatoriales Family: Oscillatoriaceae									
Genus: *Oscillatoria limosa*			+			+		+	
Genus: *Oscillatoria sp*			+			+			+
Genus: *Spirulina laxissima*			+			+			+
Order: Nostocales Family: Nostocaceae									
Genus : *Nostoc ssp*		+			+			+	
Kingdom: Protista Division: Chlorophycophyta Class : Chlorophycophycae Order: Chlorococcales Family: Scenedesmiaceae									
Genus: Scenedesmus quadricanda var parvus					+	+			
Genus: *Scenedesmus dimorphus*	+	+							
Order: Ulotrichales Family: Microsporaceae									
Genus: *Microspora* sp			+						+
Order: Zygnemiatales Family: Desmiaceae									
Genus: *Closterium moniliferum*				+	+	+			
Genus: *Cosmarium sp*					+			+	
Division: Euglenophycophyta Class: Euglenophycophyceae Order: Euglenales Family: Euglenaceae									
Genus: *Euglena ssp*	+	+	+		+				
Division: Bacillariophycophyta Class: Bacillariophycophyceae Order: Centrales Family: Thallassiosiraceae									
Genus: *Cyclotella meneghiniana*	+	+			+		+	+	+
Order: Pennales Family: Cymbellaceae									
Genus: *Cymbella sp*				+					
Family: Navicullaceae									
Genus: *Caloneis ssp*	+	+					+		+
Genus: *Navicula ssp*	+	+						+	
Family: Nitizchiaceae									
Genus: *Nitizchia vidonichi*		+							+
Genus: *Nitizchia sp*	+							+	

Conclusions

1. Effect of physiochemical properties of sewage water on algae quantitatively and qualitatively in the study sites.
2. The dominion of diatoms over other species of algae.
3. It was found the species *Caloneis*, *Cymbella*, *Cyclotella* appeared throughout the study period and in most of the sites , which indicates their resistance to pollutants and to the variance of environmental factors.
4. Effect of excreta excreted in sewage water on nutrient concentrations.
5. The inefficiency of the sewage treatment plant in Tuz khurmatu to get rid of pollutants such as oils, grease and fuel, due to the lack of conformity of some of the study factors with the local and international specifications for sewage water.

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