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The effect of the industrial wastewater of Al-Furat company for chemical industries and pesticides on the quality of euphrates river

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Abstract:

This research was deals with the specifications of the industrial wastewater of Al-Furat company for chemical industries and pesticides, which are discharged to the Euphrates river and the extent to which they conform to the Iraqi specifications of the river maintenance system. This study divided in two stages. The first stage was included the study physical and chemical properties of the industrial wastewater, The laboratory analyzes of physical – chemical characteristics were carried out for the water coming out from the treatment unit of the, which includes pH measurement, total dissolved solids TDS, total suspended solids TSS, Sulphate (SO_4), chlorides Cl^- and chemical oxygen demand COD for the period from July 2016 to February 2017. While the second stage was included the study of the determination for heavy metals such as (Pb, Cu, Fe, Cr, Hg) in both phases dissolved and particulate in water. The samples of the testing for the heavy metals were taking from three stations.

It was found that the physical - chemical specifications of effluent water from the treatment unit for the most effects within the permissible limits excepting total dissolved solids (TDS) and electrical conductivity don't meet with permissible limit. It was also noticed through the statistical analysis that there are differences in the interpretation of most of the effects due to fluctuations in the production of the company in terms of quantity and quality from time to another. While the result of the study was shown that the concentrations of heavy metals in the particulate phase were higher than those in dissolved phase in water .

Keywords: heavy metals, industrial waste water, physical and chemical characteristics, Euphrates River

Introduction

Environmental problems are one of the most complex problems affecting the world today and threaten its future existence. These problems have become a reality for every human being in this world, especially after modern technologies and industries have caused damage to the environment, threatening to destroy many plants and organisms and depleting natural resources. River is the main water supplier for municipal, industrial and agricultural uses, the study of water quality has become in one river is important to assess the problem of water pollution. Industrial waste from factories in different quantities important source for the pollution. Industrial effluents are indicators of the nature of the risk to the aquatic environment of the river as it contains chemicals and various industrial materials [1,2]. Many researchers have turned to study the impact of industrial waste on river quality, such as:

The effect of heavy metals in the effluent from a textile factory in the city of Erbil on the characteristics of Tigris river was studied. As well as other researchers were studied of the physical and chemical characteristics of wastewater from the paper industry, which uses waste paper as raw material[3].

The results of study the specifications of liquid industrial waste from leather tanning factory and its impact on the water of the Tigris river were illustrated that the pollution indicators represented (BOD, TDS) a clear effect on the water characteristics of the river, while the other indicators(PH, TH, Cl, NO3, PO4, S, TSS) does not exceeds the max. permissible limits[4].

The result of study the distribution of the some heavy metals concentration for Tigris river in three stations in Baghdad, was showed that the station number(3) was more polluted from other stations and a slight effect had not exceeded the permissible limits[5].

The results of study the physiochemical properties and heavy metals of water and soil collected from Ghol dam of Bahadar Khel at district Karak, Khyber Pakhtunkhwa province of Pakistanwere showed that the concentration of heavy metals in order: Ca > Fe > Zn > Cu > Ni > Pb = Cr of water samples while the concentrations of heavy metals of the soil samples in the order: Fe > Ca> Cu > Zn > Pb > Ni = Cr. The physiochemical properties (pH, Ec and TDS) for the water and the soil were showed with allowable limit and the water of lake is suitable for fish breeding[6].

Material and Methods

The heavy metals concentration in industrial wastewater was determined by authors depend on standard literature procedures in the research work. The method consists of Atomic Absorption Spectroscopy. Samples were collected from the industrial wastewater of Al-Furat Company for chemical industries and pesticides which disposed in Euphrates River after treatment. Samples were collected in the July 2016 to February 2017for chemical- physical characteristic testing such as (pH, EC, TDS, TSS, BOD…..). The determinations of heavy metal concentration in this research were including (Fe, Cu, Cr, Hg and pb). The sampling of heavy metals testing was taking three stations for industrial wastewater after treatment. The first station was located inside the company where the wastewater disposal in the drainage after treatment, the second station was located at south east of the company and far (10) km from the first station and the third station was located directly (15) km from the second station.

Electrical Conductivity

The electrical conductivity was measured by a conductivity meter (L17), manufactured by Bischof, Germany, and electric conductivity was expressed in unit micro-Siemens (µS / cm).

pH

Use the Microcomputer pH-meter 1842, manufactured by HANNA after calibration with standard buffering solutions.

Total Dissolved Solids

Filtrate 100 ml of the sample on the dissection paper (0.45) micrometer and collect the leachate in a jar weight noted (B), then evaporating the leachate in a temperature oven ranging from 103 to 105 °C for 24 hours and after which weight (A) .

TDS= $((A\text{-}B)*10^3/\text{Vol. of Sample ml})$

Total Suspended Solid

Filtrate 100 ml of the sample on the dissection paper (0.45) micrometer weight information (B) and then dry the paper in an oven temperature range from 103 - 105 °C for 24 hours and then the weight is measured (A) [7].

TSS= $((A\text{-}B)*10^3/\text{Vol. of Sample ml})$

Sulfate

Sulphate were measured using the brownish method was shown in [7] . It was measured by using a spectrophotometer with wavelength of 420 nm .The Sulphate was expressed in unit (mg / l) [8].

Chloride

The chlorides were measured by titration the sample by the distilled water with the silver nitrate ($AgNO_3$) with potassium chromate to the point of the end of the reaction which appears in reddish brown [8].

Cl (mg/l) = $(m_1\text{-}m_2)*$ 35.45*1000*N/ Vol. of sample

Where:

m_1: represents the reading of the sample.

m_2: is the sample reading of the sample Planck (we repeat the same experiment, but instead of putting the sample, we replace it with distilled water).

35.45: represents the molecular weight of chromium

N represents $NaNO_3$ silver nitrate

Vol. Of sample = Sample size in mm

Chemical Oxygen Demand(COD)

The amount of oxygen consumed to analyze or oxidize carbonate organic matter whether biodegradable or not by a strong oxidative agent such as potassium chromate dioxide. This test also reflects the extent of water pollution. However, this test has a rapid oxygen uptake of 2 hours. The colorimetric closed reflex method was used to measure the amount of oxygen requirement.

Dissolved & particulate Heavy Metals

The industrial wastewater was transferred to the laboratory while maintaining the temperature of the model and then filtering one liter of water through the filter paper (diameter 0.45 micro Sartorius). The leaves were diluted with nitric acid (0.05 samples) and deionized distilled water [7]. The leaves were then diluted to 5 ml of concentrated hydrochloric acid.

The model was concentrated from 1 liter to 100 milliliters. The solution was ready to read the iron and lead elements using the Flame Atomic Spectrometer Absorption Spectrophotometer) Model 680 Shimadzu type and remote control concentrate in mg/L units.

As for the method of measuring the amount of particulate UY` heavy metals, the filtration paper used for filtration of the water sample at 70 ° C for 48 hours for the purpose of plankton extraction and extracting element ions is dried with 0.5 g of dry sample and placed in special containers for this purpose and treated with a mixture of 6 ml hydrochloric acid (6 ml) and concentrated nitric acid (1: 1), heated to 80 ° C and evaporated to dry, then 4 mL of concentrated hydrochloric acid and hydrochloric acid mixture is added (1: 1). Drain and then dissolve the precipitate with 20 mL of acid (0.5 N) and leave for ten minutes. The sample is then centrifuged at 3000 rpm for 20 minutes and placed in a 25 mL volume container. The precipitate is washed with ions-free water and the vial is added after removing the precipitate. The size is supplemented to 25 ml and the samples are kept in clean, labeled plastic bottles for the purpose of measurement by an atomic absorption device. The results are expressed as micrograms / gm [7].

Results and Discussion

The study of the determinations of the physical and chemical parameters of the industrial wastewater of the company was determined by the exit of the treatment plant with a focus on water stagnation and lack of herbs and their validity for sampling. Pollution indicators of ion hydrogen pH, electrical conductivity Ec, total dissolved solids TDS, total suspended solids TSS, Sulphate So_4, chloride Cl^- and chemical oxygen demand COD.

The Figure (1) shows the highest pH value was recorded in September at 8.3, while the lowest pH value in August was 6.5, which means that the value of pH throughout the study period was within the permissible limit according to the Iraqi specifications for the system of river maintenance for 1967. While the table (1) shows the statistical analysis of the reading rate was within the standard and the deviation from the average was small and the range of the value indicated that the data were close and homogeneous. There is a strong correlation between the value of pH and the concentration of carbon dioxide (not related) in water [9]. The increase in the efficiency of photosynthesis leads to the consumption of carbon dioxide and this is a major reason to increase the values of pH [10]. [11] pointed out that the narrow range of pH values refers to buffer capacity, where changes in pH values are resisted. This phenomenon was also observed by [13] when studying Saqlawia drain.

It was noted during the study period that the highest value of electrical conductivity was during July, while the lowest value during the month of February, as noted in the statistical analysis that the reading rate was outside the standard and deviation from the rate was large and the value of the range indicates that the values of electrical conductivity during the study period was not close. Figure (2) shows the monthly variation of electrical conductivity values (μs / cm) in the study site. There is a close relationship between both the electrical conductivity and the amount of dissolved salts in water as the electrical conductivity is an indicator of the amount of dissolved salts in water [13]. The electrical conductivity increases in places under the influence of agricultural and industrial activities. Electrical conductivity depends on the total concentration of ionized matter and water temperature [14].

The Figure (3) shows a difference in the values of total dissolved solids during the study period. It was noted that the highest value was at December, while the lowest value was at February. By observing the statistical analysis it was found that the reading rate was not within the Iraqi specifications for the system of river maintenance for 1967. Range indicates that the data were spaced and non-homogenous and this indicates the non-homogeneity of concentrations of parameters after treatment. The total amount of dissolved solids recorded a rise in their values, which was agreed upon with other studies [15].

During the study period, the highest value of total suspended solids was observed in July, while the lowest value was in October. All readings were within the Iraqi specifications for the river maintenance system as shown in Figure (4). The range of readings is small and this indicates the homogeneity of the effect concentrations. The concentration of the total suspended solids Indicates the efficiency of treatment of waste water in treatment plants [16]. One of the most effects of increasing the suspended solids is the reduction of light permeability through water, which reduces photosynthesis processes [17].

During the study period, sulfates values ranged between the highest value in the month of August and the lowest value in February. Most of the readings were within the permissible limits according to the specifications of the Iraqi River Maintenance System for 1967 as shown Figure (5). The readings were outside the limits of the standard and there was little deviation and the value of the range was fairly homogeneous. That the high concentration of sulfate in the wastewater from the permitted limit is due to insufficient ventilation conditions in the treatment, which helps to cause anaerobic conditions that lead to the transformation of sulfates into hydrogen sulfide gas under the anaerobic conditions that microorganisms directly interfere with the reduction of sulfates to hydrogen sulfide [18].

The results showed that the highest value of chlorides was in September, while the lowest value in November was all readings within the permissible limits, and that the deviation and the range of their values are large, this indicates the heterogeneity and fluctuation of data as shown in Figure (6).

The Figure (7) was shown that the monthly variation for chemical for oxygen demand were within the limits of the Iraqi standard for the maintenance system for 1967 and that the rate, range and deviation were homogeneous and within the specification. This indicates the homogeneity of the effect concentrations after treatment. The high concentration of COD represents to the organic materials that consume dissolved oxygen which leads to the migration and the death of aquaculture [19].

Heavy metal concentration in samples were found in the order: Fe >Hg >Cr >Pb > Cu at particulate phase while in the order: Fe > Cu > Hg > Cr > Pb ≈0 in dissolved phase. There are many factors that affect the concentrations of heavy elements in the water of the drain, which enters into the water of the drain from the deposits and thermal activities as a result of interactions within the hydrothermal processes (deposition of materials from the layers of the atmosphere as well as adsorption on surfaces and sedimentation and accumulation by aquatic organisms. The diversity of these elements and their entry into the watercourse [20]. [21] were noted that atmospheric changes affect the transport of pollutants and the chemical of heavy metals. These changes are caused by human activities and to industrial and agricultural wastes. The concentration of heavy metals is increased when decrease of pH in limited value.

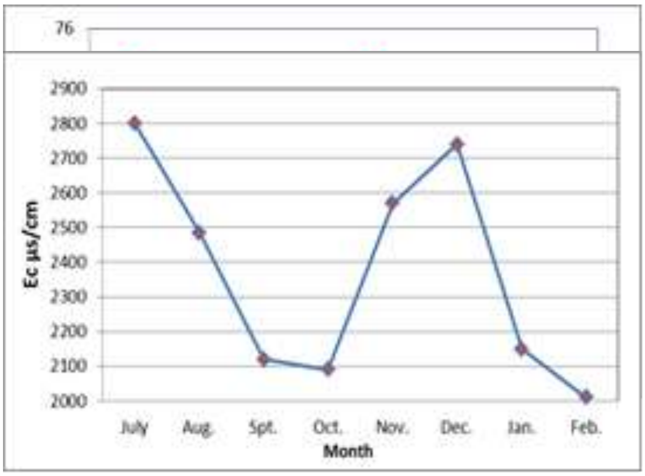
The hardness reduces the toxicity of heavy metals and increases by reducing dissolved oxygen, temperature and pH values. There is a strong correlation between the hardness and toxicity of heavy metals. hardness and alkalinity water is due to low values of heavy metal concentrations[22].

Biological environmental indicators have a significant role in the concentration and presence of heavy elements such as the density of aquatic organisms such as phytoplankton. The difference in the concentration of heavy metals is due to the variation in the quality of industrial waste, which greatly contributes to the concentration of these elements [23].

The presence of heavy elements in the waterway indicates the natural factors and human activities that enter different ways in the watercourse. The concentration of heavy metals is always high because of the difference in the density of different groups, the hydrological nature and the nature of industrial waste that is brought into the waterway [24].This is what we observed in Station NO. (1) where the place is open and not surrounded by plants, unlike Station NO. (3). This helps the molecules to become smaller and give them greater chances of absorption.

Table 1. Concentration of physical and chemical parameters and some descriptive statistics

Date	PH	EC	TDS	TSS	SO4	Cl	COD
July	6.9	2800	1317	67.3	422.8	625.5	25
Aug.	6.5	2485	1106	43	472.1	350	95
Spt.	8.3	2120	1338	35.6	375.5	732	144.2
Oct.	8.1	2090	1400	33.3	392.8	530.8	70
Nov.	7.3	2570	1200	66.6	450.6	662.6	152.6
Dec.	8.1	2740	1600	40	463	639	24
Jan.	8	2150	1500	45	385	610	45
Feb.	7.6	2010	1085	35	360	450	35
Average	7.6	2370.625	1318.25	45.725	415.225	574.9875	73.85
Max. value	8.3	2800	1600	67.3	472.1	732	152.6
Min. value	6.5	2010	1085	33.3	360	350	24
Range	1.8	790	515	34	112.1	382	128.6
standard deviation	0.648074	314.8519	182.4161	13.70034	42.87906	124.4403	51.85945
Standard Specifications	6 - 9.5		1000	60	400	600	



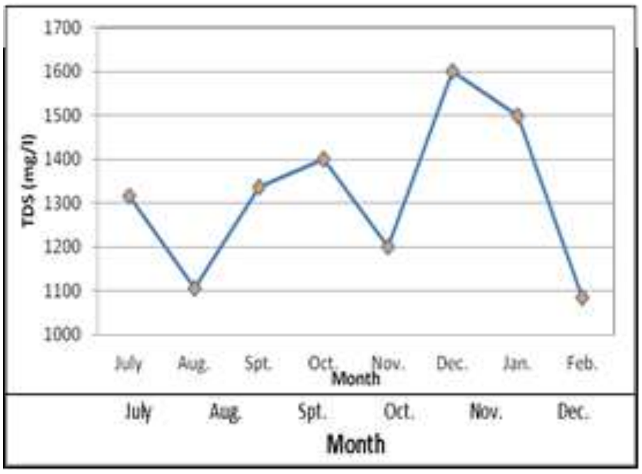


Fig.1**:** Monthly variation of pH values

Fig. 3**:** Monthly variation of the amount of Total dissolved salts

Fig.2**:** Monthly variation of electrical conductivity values

Fig. 4**:** Monthly variation of the amount of Total suspended salts

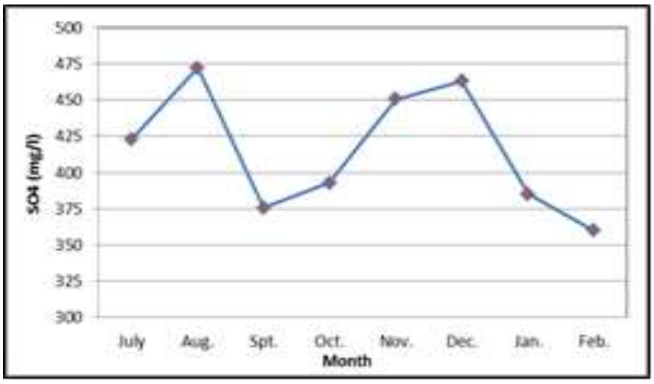


Fig.5**:** Monthly variation of Sulphate

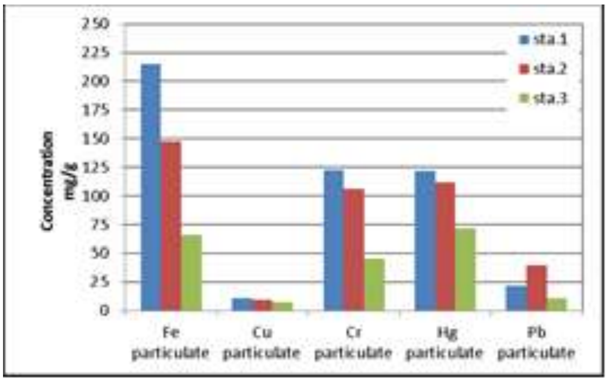


Fig. 8**:** Concentrations of heavy metals in particulate phase

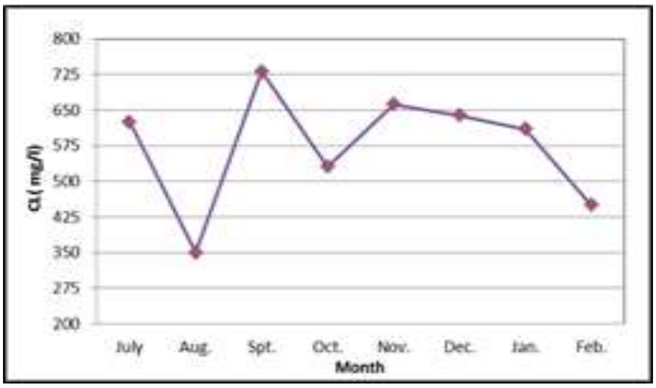


Fig. 6**:** Monthly variation of chloride concentration

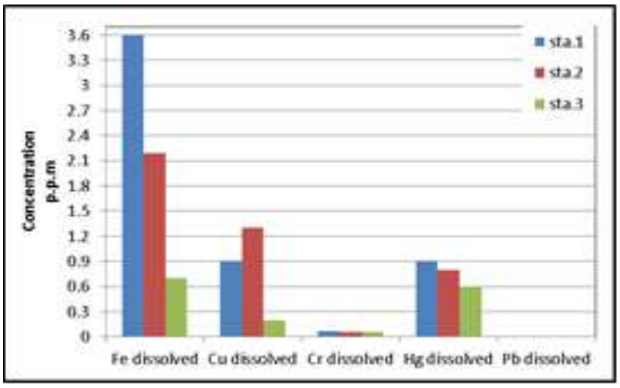


Fig. 9**:** Concentrations of heavy metals in dissolved phase

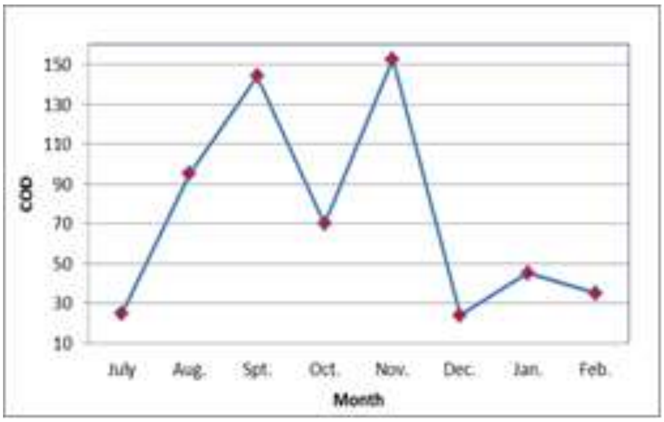


Fig.7**:** Monthly variation of concentration of chemical oxygen demand

Conclusions

(1) Industrial water has a significant impact on changes in physical and chemical properties of river water

(2)The physical, chemical and heavy metals properties oscillation during the study period is due to the irregular industrial waste subtraction by the Company

(3)The heavy elements in the particulate phase were higher than the dissolved phase during the study period

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