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Chemical Compositional Pattern of Textile and Tanning Wastewater Factories That Built on the Tigris River Banks -Iraq

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Abstract
This study was regarded as a pioneering by presenting or description a summary of the textile and tanning factories wastewater effluents' that harmful effects on the food chain individuals then to humans. The current study was aimed to study the nature and features of the textile and tanning factories wastewater that located in the Was sit and Baghdad Province. The results of the physical properties showed that the waste water of the two factories is alkaline and yellow color for the textile factory while its turbid for the tanning factory, with pH values were 7.2 to 7.6 fortextile and tanning factories, respectively , it was also characterized by being hardness wastewater and with high values of total dissolved solids and electrical conductivity. The wastewater of the textile was also characterized by its containing high levels of sulphur, which gave it a yellow color. Calcium, nitrate, sodium, chlorine, phosphate and magnesium were found in varying proportions in the both of wastewater factories, with a high percentage of heavy metals such as barium, cadmium, chromium and lead in the Textile factory wastewater while cobalt, nickel, lead and cadmium was present in the tanning factory wastewater.It was concluded that the presence of all these elements has a significant hazard environmental impact on the aquatic life of living organisms, which have a harmful effect on the food chain for other living organisms.

Keywords: Wastewater, Textile, Tanning, Tigris River, Factories

Introduction

Textile industries represent one of the oldest known industries in Mesopotamia, as scholars believed it to be its first home(Parsonsand Rose, 2003).This industry is one of the diverse processes depending on the nature of production(Nosheen et al., 2002).As for theireffluents, it is one of the most important sources of increasing pollution, which must be within the permissible limits and this case was so difficult, especially with some parameter such as:-total dissolved solids, the chemical oxygen requirement COD, heavy elements and color(Cheu et al., 2005).

The impact of the leather tanning industry on the environment is an ongoing and growing problem, andthere water consumption varies widely between them, depending on the processes involved, the raw materials used, and the products manufactured. However, a large amount of freshwater wasused to leather process with many hazardous chemicals such as:Chromium, synthetic compounds, oils, resins, biocides and detergents that are released(Sureshet al., 2001; Nazer and Siebel, 2006;Mohammedet al., 2017). Concerns about their effluents from this industry are mainly due to synergic chronic toxic effects, which can be released into the environment(De Nicolaet al., 2007), or it may inhibit the nitrification process(Jochimsen and Jekel, 1997).

The liquid industrial waste is one of the dangerous influences on the properties features of the water bodies because it contains various chemicals and industrial materials(Omranet al., 2012). Therefore, several researchers have tended to study the Iraq's water bodies limnology such as: Al-Azzawe et al. (2012);Hassan etal. (2014);Ala Allah et al. (2014); Salman et al.(2015);Al-Shamy et al.(2015);Nashaat et al. (2015); Rasheed et al. (2015); Mirza and Nashaat (2018);Alazawii et al. (2018) ;Abed and Nashaat (2018);Rhadi et al. (2018);Nashaat et al.(2019; 2020); Khalaf et al.(2021); Nashaat and Al-Bahathy (2021); Majeed et al. (2022);Abed et al. (2022). While other studies dealt with the impact of industrial institutions waste on river water (Al-Azawii et al., 2015) , or sewage treatment plants(Salman et al., 2017)

at Kut City, while other studies dealt with the impact of electricity power plant (Dura power plant)effluents (Nashaat, 2010)and Al-Rasheed power plant (Muftin *et al*., 2019) , while the rest of the studies focused on the effects of heavy elements effluents resulting from the textile factories on the rivers parameter, or the effect of the waste from leather tanning factories as an influential party in increasing the impact of industrial chemical and biological waste on the rivers properties..Therefore, The current study was aimed to study the nature and features of the Kut textile wastewaterfactory which located on Wassit Province and Zafaraniya tanning wastewater factories that located in the Baghdad Province, which were discharging liquid toxic substances directly to Tigris River with a simple and old treatment, that leads to the occurrence of many genetic or chronic diseases.

MATERIALS AND METHODS

STUDY AREA

Kuttextile factory and the Zafaraniya tanning factories are considered one of the important industrial institutions in Iraq, which they are located on the Tigris River banks.Kut Textile Factory was established in Wass it Province on the left side of the Tigris River banks (Plate 1), which was designed to produce cotton fabrics (100%), and produce spread cotton yarn with different sizes to feed the textile Department in the factory. Construction work, machinery and equipment was completed and installed in 1970(Shendi , 2008).

Plate (1): - Diagram of the Kut Textile factory in Wassit Province.

As for the Zafaraniya tanning factory that locatedon Baghdad Province, it was established about 250 metersaway from Tigris River on the left bank, because the tanning industry needs large amounts of water to be used in the various stages of production. In addition to that, the site needs to drain large quantities of industrial water to the nearest water source after simple and old treatment. In addition, the area in which the factory was established is an open agricultural area to dilution emitted gases from tanning and leather solutions(Ismail, 2016) (Plate 2).

Plate (2): - The location of the Zafaraniya tanning factory (Source: Land Sant 8 Satellite, 2013).

Samples were collected from two factories. The sample were taken to specialized laboratories in the Ministry of Science and Technology for physical and chemical properties and chemical composition analysis.

Some characteristics were conducted at the study site directly, such as, electrical conductivity, total dissolved solids, and pH. The electrical conductivity and total dissolved solids were measured by using an Electrical Conductivity Meter of Martini Instruments,(Spellman, 2015). The pH was measured by using Hanna (H19811). Turbidity was measured with a Jenwaw Model 6035 turbidity meter. The dissolved oxygen and the Biological Oxygen Demaned BOD were measured by Modification Azid Winkler's method (EPA, 2012; Baird & Eaton, 2017; Spellman, 2020). The percentage oxygen saturation was calculated based on(EPA, 2012). The total hardness, calcium and magnesium were measured according to standard methods(Baird et al., 2017) . The sulphate ion was measured according to the procedure described by Brands and Tripke(Brandset al., 1982). Phosphates were measured by using ascorbic acid, Uv spectrophotometer was used to measure nitrate as described by the standard method by Baird et al.(2017). Sodium were measured by Flam photometer (JEN Way PEP6)as described byUSEPA(2012). Finally, the chlorine was determine by Mohr's method (APHA, 2005). The oils percentage in the two wastewater factories was measured by the Oil Content Analyzer, type HORIBA-OCMA-350, Made in Japan.Concentrations of heavy metals (Cadmium, Chromium, Cobalt, and Nickel) were estimated directly after filtration water samples by methods approved in the American Health Organization (APHA, 1976),and ASTM (2006), by using Flame Atomic Absorption / Flame Emission Spectrophotometer (AA-7000) from Shimadzu Company withPc Hitachi. A Gas Chromatography type Shimadzu GC-AG7 equipped with an ionization flame probe (FID) was used to estimate the tow types ofhydrocarbons concentrations, Polycyclic Aromatic Hydrocarbons (PAHs) and Polychlorinated Biphenyls (PCBs) based on the Ezzel *et al*. methods (Babb, 1992).

Results and Discussion

The physical properties of thetextile wastewater factorywas alkaline and yellow color, and the average pH values are 7.2. It was also characterized as a very hardness wastewater and with high values of total dissolved solids and electrical conductivity. It also contains high levels of sulpher, which gives it a

yellow color. Calcium, nitrate, sodium and chlorine are found in varying proportions, and this may be depends on the type of chemicals used in that water(Table 1). Chemical analyzes of that wastewater showed that it contained some other materials such as phosphate PO_4 and magnesium. In addition, there was a high percentage of heavy metals such as:Barium, Cadmium, Chromium and Lead.While the wastewater of the tanning factory (Table 1) was transparent and alkaline, with pH values 7.6 close to the values of the textile wastewater. It was also characterized by being very hardness wastewater with high values of total dissolved solids and electrical conductivity. As well as sulpher SO_4 with a relatively lower concentration than textile wastewater factory and calcium and sodium salts, as well as chemical analyzes showed the presence of high amounts of heavy metals such as:Barium, Cobalt, Nickel, Lead and Cadmium, all of these elements have a serious environmental impact and have harmful effects on the water quality in Aquatic life organisms and humans.

Table (1): -Physical and chemical properties of wastewater from textile and tanning factories.

Factories Parameter	Textile	Tanning
pH	7.2	7.6
EC(µS/cm)	1467	969
TDS(mg/L)	957	788
Turbidity (N.T.U)	350	433
Total Hardness(mg/L)	487.24	340.25
SO_4(mg/L)	431	267
CL (mg/L)	231	312
PO_4(mg/L)	33	22
NO_3 (mg/L)	10	10.3
Ca(mg/L)	139	95
Mg(mg/L)	34	25
Na (mg/L)	149.5	73.0

Results of Chemical Analysis

It was found that the amount of oils in the textile andtanning wastewater reached to 14.5 and 9.58 mg/L, respectively (Fig. 1).

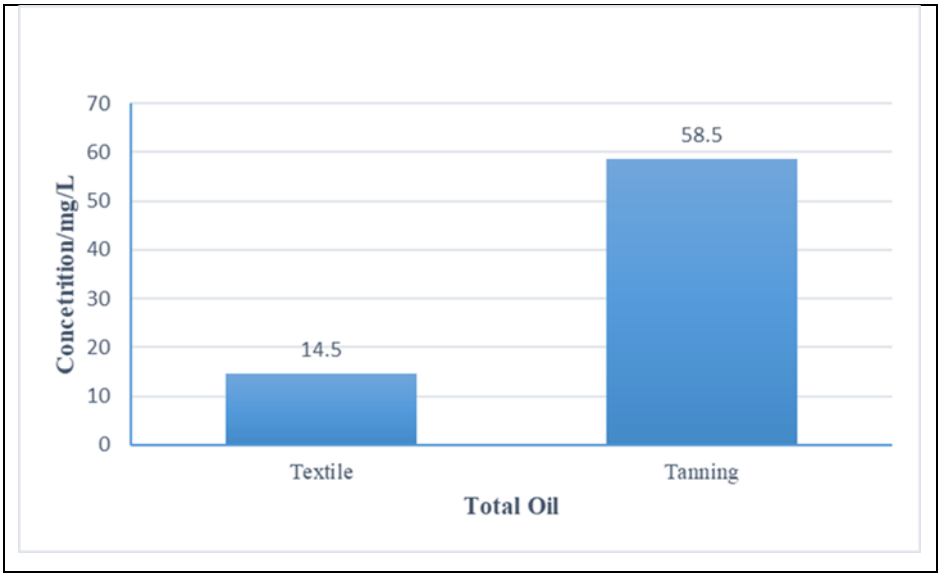

Fig. 1. The total amount of oils in the textile and tanning factories.

The results of the chemical analysis in the textile and tanning factories wastewater showed presence of heavy metals, but with varying concentrations. The presence of Cd, Pb, Cr, Co, and Ni was

recorded in the textile wastewater, while Ni $^{+2}$ and Cr^{+2} appeared with highest concentrations, which amounted to 0.165 and 0.12 mg/L, respectively (Fig. 2).

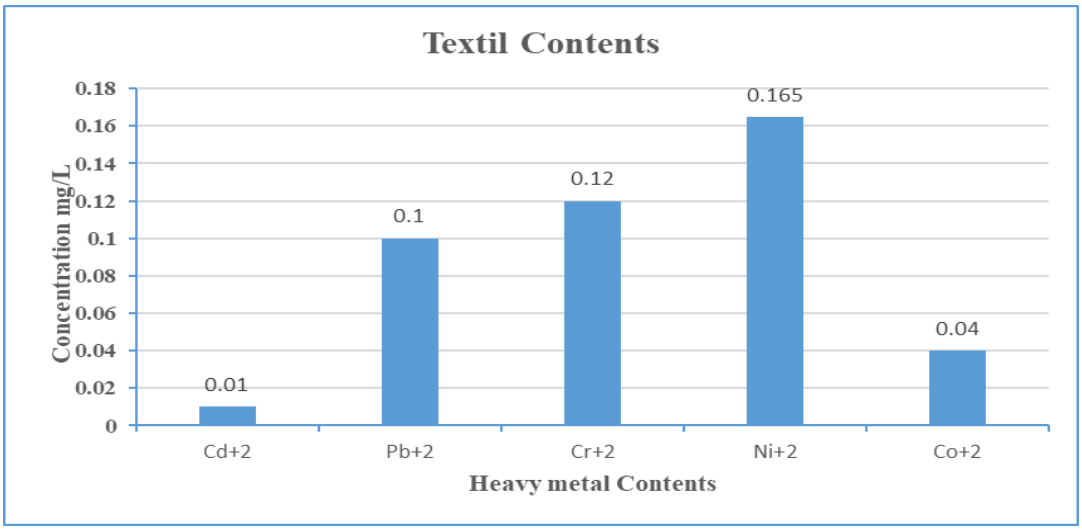

Fig.2.Concentrations of heavy metals in the textile factory.

In the same way, it was recorded Cd, pb, Cr, Co, and Ni, with highest values of Cr^{+2} and Ni^{+2}, which amounted to 0.34 and 0.19 mg/L, respectively in the tanning factory wastewater (Fig. 3).

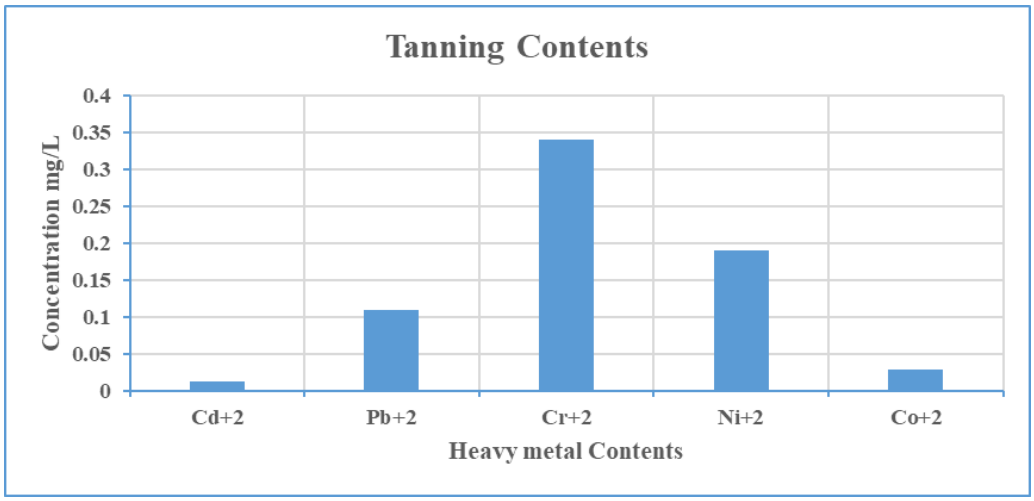

Fig. 3. Heavy metal concentrations for the tanning wastewater factory.

Chemical analyzes showed that presence of other chemicals including polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). Eight polycyclic aromatic hydrocarbons (PAHs) were recorded in the waste water of the textile factory, with highest value was recoded for toluene and benzene, which were 19.54 and 13.1 mg/l, respectively(Fig. 4).

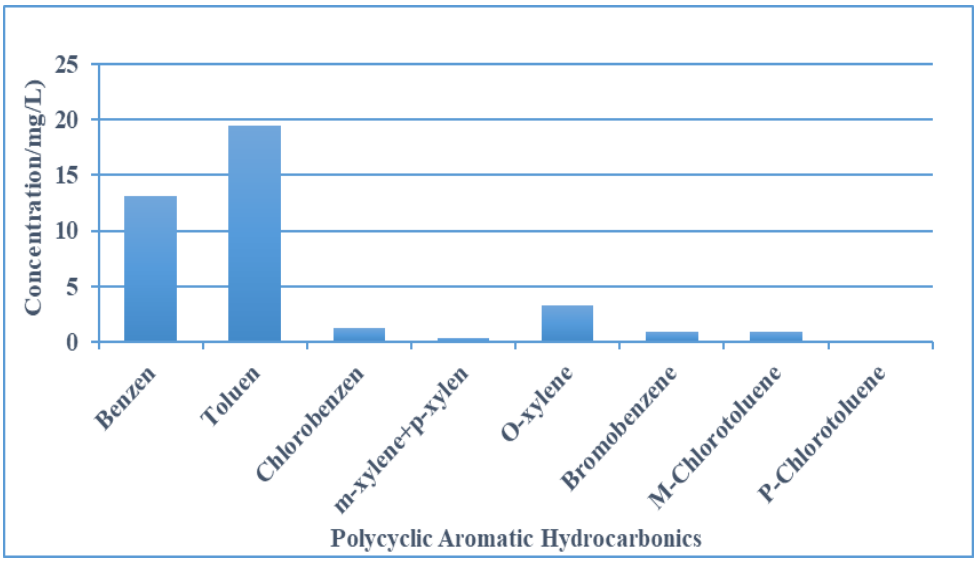

Fig. 4. Concentrations of polycyclic aromatic hydrocarbons (PAHs) for the textile wastewater factory.

As for the concentrations of polychlorinated biphenyls (PCBs), the number of elements present in the textile wastewater factory was 13 elements, as the highest value was 44.5 mg/L for the 1,2-Dichloroethane and the lowest value was 0.05 mg/L for the 1,1,2 ,2-Trichloropropane, (Fig. 5)

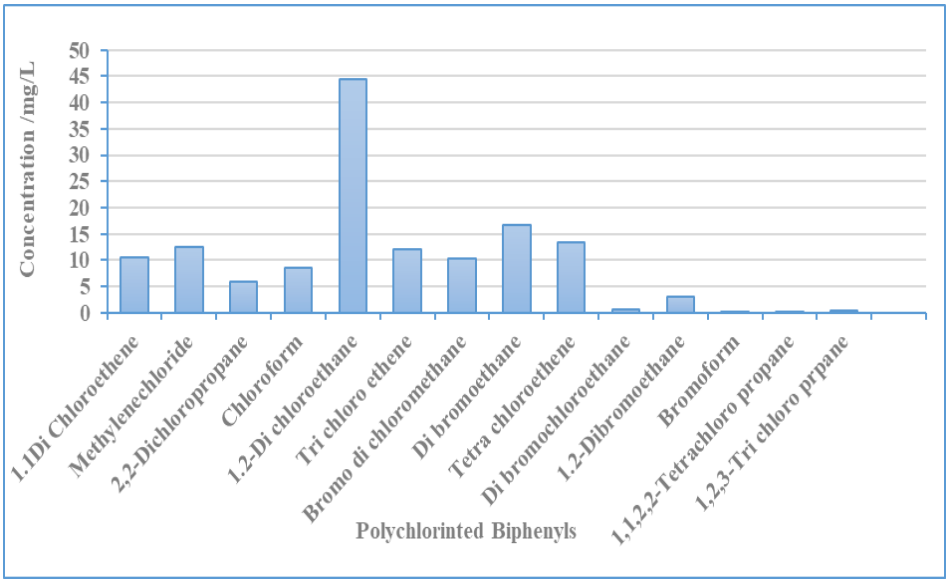

Fig.5. Polychloride biphenyl PCBs for the textile wastewater factory.

Also, chemical analyzes of polycyclic aromatic hydrocarbons (PAHs) in the tanning wastewater factory showed the presence of six hydrocarbon compounds, the highest value was 33.9 mg/L for Benzene and the lowest value was 1.2 mg/L for Chlorobenzene (Fig. 6).

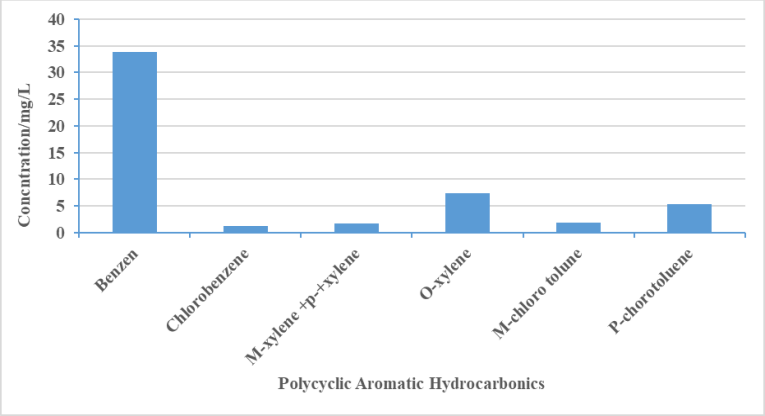

Fig. 6. Concentrations of polycyclic aromatic hydrocarbons (PAHs) in a tanning wastewater factory.

Eight elements of polychlorinated biphenyls (PCBs) of the tanning wastewater factory was recorded, the highest value was Di bromo chloromethane, with a value of 167.2 mg/L, and the lowest value was Bromoform and 1,1,2,2-Tetrachloro Propane, which amounted to 1.5 mg/L for each (Fig. 7).

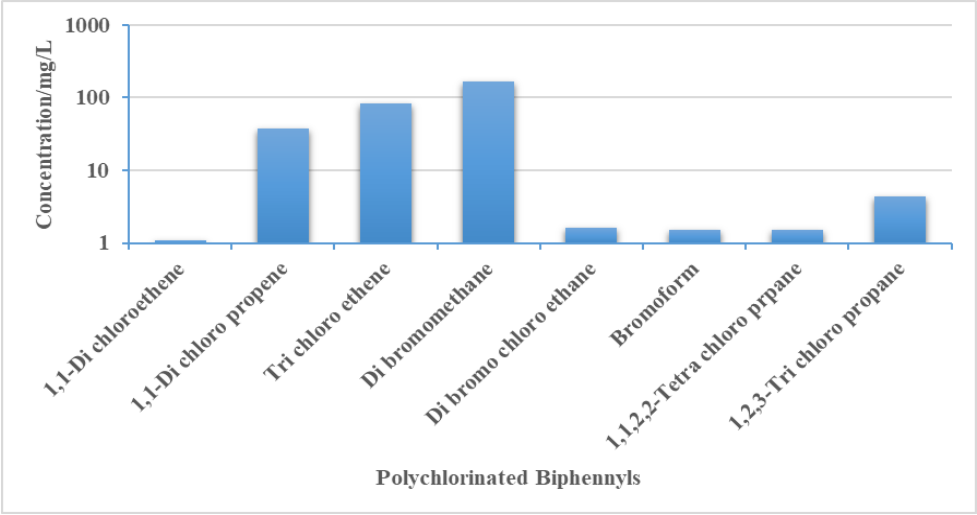

Fig. 7. Polychlorinated biphenyls PCBs concentrations for the tanning wastewater factory.

Heavy metal appear in different shapes and states, as they are either dissolved in water or adsorbed on the surface of plankton and sediment(Khalaf, 1997). The physical and chemical properties of the Tigris River have mostly exceeded the permissionlimits of the Iraqi and World Health Organization standards (WOH)(WHO, 2002;Al-Hiyaly et al., 2015),also, Tigris River was recorded a group of heavy metal including Cd, Ni, Fe, Cu, Cr and Pb (Alazawiiet al., 2018; Al-Lami et al., 1999)and this case may be related to the high concentrations of metals in the wastewater that was released into the river without any treatment of this effluents.The presence of all these elements has a significant and hazardenvironmental impact on the aquatic life of living organisms, which have a harmful effect on the food chain for other living organisms.The aquatic ecosystem is considered the final reservoir for all toxic elements in the environment (Altindaget al., 2008), as the agriculture and industry development leads to the arrival of many heavy toxic elements to oceans, rivers and lakes, which leads to pollution of the aquatic ecosystem with heavy elements, and this pollution becomes throughout the years is more complex and more harmful to aquatic organisms(Gomez-Diazet al., 2009).As these elements accumulate in the phytoplankton, zooplankton and fish(Dasaret al., 2009), and lead to changes in development, growth, reproduction, behavior and death to some organisms in the aquatic ecosystem(Offem andAyotunde, 2008). The toxicity of these elements may be due to their association with active molecules in the body such as proteins and enzymes, which leads to the formation of stable toxic compounds in the body (Duruibe et al., 2007).

Although the aquatic ecosystem possesses the physical, chemical and biological mechanisms to eliminate or reduce the toxicity of these elements,but it becomes harmful at particular levels as a result of its accumulation in high concentrations in the aquatic food chain(Offemet al., 2008).

Polycyclic aromatic hydrocarbons PAHs are a serious environmental concern due to its high toxicity, mutagenic potential, and carcinogenicity. The toxicity of PAHs depends on the type of constituent compounds, molecular structure, and exposuremethods (Douben, 2003). A higher concentration of these PAHs is likely to lead to adverse biological effects on aquatic organisms. Ecologists have developed a guideline based on the relationship influence between pollutant concentration and the organism's toxic response.By using, these values to estimate the amount of contamination in sediments(McCreadyet al., 2006; Liu, 2009; Longet al., 1995;Wang et al., 2007)based on the toxicity of polycyclic aromatic hydrocarbons. As announced by the US Environmental Protection Agency (USEPA, 1974) sixteen of polycyclic aromatic hydrocarbons are priority pollutants.In addition, all these compounds registered in the wastewater of the textile and tanning factories are considered to have toxic effects on aquatic life, which pours wastewater directly into the Tigris River without treatment. Similar situation was recordedin the water bodies of most industrialized countries, as well asrecodedPCBs level in the Seine River (France) was from 50-150 ng/L in the rainy season (Chevreuiletal., 1987). These PCBs have also been recorded in most of the Seven Seas of China (Huai River, Yangtze River, Pearl River and Songhua River) (Zhanget al., 2009).

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