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The efficiency of drinking -water-treatment processes in removing of some PAHs compounds from water in Erbil city-Iraq

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Abstract

water samples at each treatment step of drinking water treatment plants(DWTPs) in Erbil city were collected to study sixteen PAHs componds listed by USEPA as priority pollutants and determine the efficiency of each process in removal of PAHs .The highest values of(0.313µg/L and 0.233 µg/L)were recorded for Benzo(k)flouranthene in DWTP 1 and 2(Efraz 1,2)during June 2008 in raw water ,while the highest value of 0.174 µg/Lwas recorded for Acenaphtheen and flourene during june 2008 in raw water at Efraz 3.No values were recorded for Low molecular weight PAHs during the study periods at DWTPs in some treatment steps. The lowest values in the tap water(treated water)which reffered to the efficiency of treatment processes in removing of PAHs from the source water. mean concentration of Total PAHs compounds which ranged between (0.150-1.43 µg/L), (0.081-1.462µg/L) and (0.080-0.0941were recorded at Efraz 1, 2 and 3 during June 2008 and April 2009 in in source water and tap water respectively. the removing percentage of totl PAHs were (84%,90% and 85%) and (83%,92% and 86%) were recorded at Efraz 1,2,3 during June2008 and April 2009 respectively.The highest values were recorded for 5-ring (BbF,BkF.BaP,DBA)PAHs at Efraz and 2 and 4-ringPAHs(Flur,Py,BaA and chry)at efraz 3 .

Key word: PAHs ,Drinking water ,PAHs removing

Introduction

Among wide variety of chemicals, Polycyclic Aromatic Hydrocarbons (PAHs) are of particular concern as a widespread ,persistent and toxic contaminants in the environment (1).They are commonly reffered to a large class of organic compounds throughout the environment and generated by natural and anthropogenic activity(2,3,4).Concidering their mutagenic, carcinogenic and teratogenic properties and their potential hazard to human health and natural ,they have attracted agood deal of attention and carcinogenic PAHs are all byond to high molecular weight PAHs ,having four or more rings (5,6,7) .Water pollution by PAHs compounds may be associated with the anthropogenic activities that represent the major sources of PAHs in addition to the natural sources(2).There are several factors which play essential role in removing of PAHs from water .It is found that water treatment processes including chlorination plays important role in removing PAHs from drinking water.chlorine react with PAHs to produce Quinones and polychlorinated aromatics (8).The effectiveness of these treatment varied widely within and among classes of compound.Some hydrophobic compounds as PAHs were strongly oxidized by free chlorine while some hydrophilic were partly removed through adsorption processes(9).Because there is no available data about the PAHs compounds listed by USEPA as priority pollutants ,the aim of the present study is collection of water sample at each treatment step of drinking water treatment plant(DWTP) in Erbil city and determine the efficiency of each process in removal of PAHs.

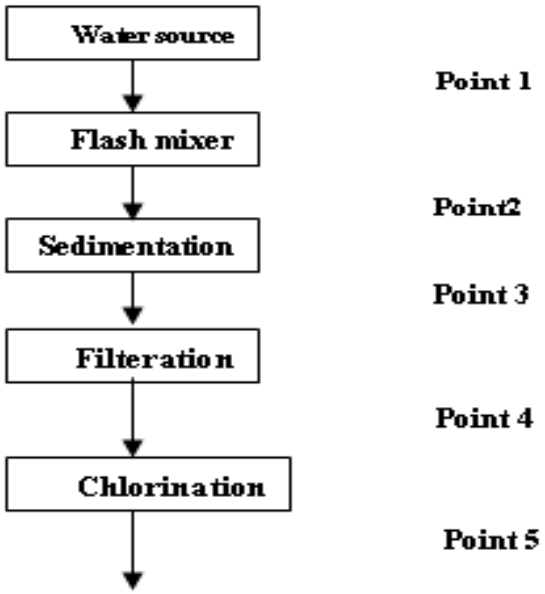
Description of Drinking water-Treatment plants and sample collection:

The upper Zap of Tigris river is provide water source for DWTP in Erbil city (Efraz 1 established in 1968), (Efraz 2 established in 1982) and (Efraz 3 that build up in 2004)..The DWTP treated m^3 and provided about 10500m^3/hr and most of water is provided from efraz 3 (8500m3/hr).Both E 1 and E3 are located to the north west of erbil city within Efraz Kamal village ,while E2 is located in Erbil city at the right side of main way of erbil-Inkawa road.

Water samples at each Efraz plant were collected in the following points

1- Raw water (low left).
2- Flash mixer (After addition of alum , polymer and Chlorine)
3- Clarifier (After sedimentation)
4- Filteration unit (After filteration)
5- High left (Tap water) after asecond chlorination and ready to be distributed

Scheme(1): Show DWTP and sample point locations



Sample collection at water treatment sites in each efraz plant were conducted during March and June 2008.Two liter of water sample at each site were collected using pre- cleaned dark glass bottle containing sixty ml of CCL**4**,then closed with aluminium foiled lined cap.

Material and methods:

Extraction of PAHs from water :

The PAHs compounds in water were determined using Liquid – Liquid extraction method as described by UNEP ,1989(10).On returning back to the laboratory, bottle sample was shaked for one hour,then the contents of the bottle were transferred to seperation funnel and allow the organic layer to separate from water phase for a minimum of ten minutes . Extraction procedure was repeated with another 60 ml of CCl**4** and the combining exracts were transferred into the flask . The organic extract was then evaporated to dryness by rotary evaporator (50ºC bath temperature and 10ºC temperature of water refrigerator circulator).Because the extract contains complex components, the clean up procedure was undertaken by column chromatography using deactivated silica gel packed in glass column(250mm×15mm l.D.). The column was pre–eluted with 10ml of Hexan, then the extract was passed through the column followed by elution with 50ml Benzene as described by Maskaoui *et al.,* 2002(11). After evaporation step, the residue was dissolved with 5 ml Acetonitrile, then concentrated to 1 ml under gentle N2 .The exract was stored at(– 20ºC) until analysis by High Performance Liquid Chromatograph HPLC .

Calibration :

A standard solution of sixteen USEPA priority PAHs was obtained from Sigma-Aldrich company as PAHs calibration mixture in order to compare the retention times and spectra of compounds in the standard with those in the sample.The standard calibration contain the compounds: Naphthalene, Acenaphthalene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrycene, Benzo(b)Fluoranthene, Benzo(k) Fuoranthene, Benzo(a)pyrene, Dibenzo(a,h) anthracene, Benzo(ghi) Perylene and Indeno(1,2,3-cd) pyrene.

PAHs analysis :

The PAHs extracts of water samples were analyzed by HPLC. The mobile phase was HPLC-grade acetonitrile and Distilled water in a linear gradient program .Ten µl of sample was injected into a stationary phase capillary column with a dimension of(15cm×4.6mm ID) and determined with UV detector at 254 nm . The flow rate of mobile phase was kept at 1.5 ml/min. The peak in the chromatogram were identified by comparing of the retention time and spectra of standard with those in the sample

Statistical Analysis:

Analysis of variance (ANOVA) on concentrations of PAHs compounds were statistically significant or not among the DWT plants(Efraz1,2 and 3).Independent T test was used to indicate which concentrations were similar to or significantly different from others between the two study periods.Removing Percentage of PAHs compounds by each water-treatment process by using the formula:

(1-[C/C0] *100)

C is the concentration in the treatment step ,while C0 is the concentration in preceding treatment step.total percentage

removing was calculated with C as concentration in finished water (Tap water) and C0 as concentration in source water [Stackelberg et el., 2007](9).

Results:

Samples of water from three Drinking-water –treatment plants DWTP(Efraz1,2 and 3) in erbil city were analysed for sixteen PAHs compounds listed by USEPA as priority pollutants were (NaP,ACPY.AcP&Flu,Phen,Anth,Flur, Py, BaA,Chry,BbF, BkF, BaP, DBA,BghiP,and IND).The concentration of sixteen PAHs which were detected in the source water (Raw water) and each step of treatment process(after flash mixer, after clarifying (sedimentation) and after second chlorination (Tap or finished water) were showed in (Figs.1-3).The highest values of 0.313µg/L and 0.233 µg/L)were recorded for Benzo(k)flouranthene in DWTP 1 and 2(Efraz 1 and 2)during June 2008 in raw water ,while the highest value of 0.174 µg/Lwas recorded for Acenaphtheen and flourene during June 2008 in raw water at Efraz 3.No values were recorded for Low molecular weight PAHs during the study periods at DWTPs in some treatment steps. There is a fluctuation in the concentrations of other PAHs compounds at DWTPs in the points of treatment steps .The lowest values in the tap water which reffered to the efficiency of treatment processes in removing of PAHs from the source water. The results reffered to the mean concentration of Total PAHs compounds which ranged between (0.150-1.43 µg/L), (0.081-1.462µg/L) and (0.080-0.0941were recorded at Efraz 1, 2 and 3 during June 2008 in source water and during April 2009 in tap water respectively.From the sum of(15,13 PAHs), (16,13 PAHs), (14,11 PAHs) ,only (5 , 6 PAHs),(11, 6 PAHs), (7, 6 PAHs) compounds were removed from the source water at Efraz 1, 2 and 3 during June 2008 and April 2009 respectively which reffered to the efficiency of drinking water treatment processes for removing of PAHs from water(table 2).Both DBA and BghiP were detected in finished water at DWTPs during the study periods .As related with total PAHs ,the removing percentage were (84%,90%,85%) and (83%,92%,86%) were recorded at Efraz 1,2,3 during June2008 and April 2009 respectively.The DWTP processes have the efficiency for removing PAHs from the water ,however some time there was the increasing in the concentrations of pAHs from one treatment step to other .The highest values of 0.62 and 0.60 µg/L were recorded for 5-ring PAHs compounds (BbF,BkF.BaP,DBA) at Efraz1 and 2 during June 2008 in tap water and source water respectively.,while the highest value of 0.35 µg/Lwas recorded for 4-ring PAHs (Flur,Py,BaA,chry)during june 2008 in tap water at Efraz 1.No values were recorded for 2-ring PAHs(NaP,AcpY),3-ringPAHs(AcP,Flur.Phen,Ant), 4-ring PAHs(Flur,Py,BaA,chry) in tap water (finished water) at efraz1 during April 2009.Also 2-ring PAHs and 2 ,4-ringPAHs were not detected at Efraz 2 and 3 respectively(table 3).The results reffered to the values ranged between (7.08-8.43), (373-471 µsm/cm), (92-194mg/L), (84-184mg/L), (3.2-12.8mg/L),(ND-2.6mg/L),(16-25.3mg/L) were recorded for pH, Electrical Conductivity EC ,alkalinity, total hardness,calcium, Dissolved Oxygen D.O.,BOD5 and chloride ion respectively.(Table 4).According to the results of ANOVA table ,no significant differences(P>50)were recorded for

PAHc concentration PAHs among DWTPs (Efraz1,2,3) during the study period.As related with time of sample collection .The Concentration of pAHs were significancy similar between time 1(June 2008) and time 2(April 2009) with exception of highest value recorded for DBA at efraz 1and efraz 2during June 2008.

Discussion:

The results of the study reffered to the high concentration of High Molecular Weight PAHs HMW-PAHs(4,5,6-ring-PAHs)in comparison to Low molecular wighet PAHs LMW-PAHs(2 and 3-ring –PAHs)in water source .The results reffered to no value or very low concentration of some Low molecular wighet PAHs in finished water in comparison to high molecular wighet PAHs((Figs. 1-3).This may be related with Low water solubility of HMW-PAHs and high partition coefficient (Kow) and high volatility of LMW-PAHs (14,15)and interaction of several processes as volatilization of Low Molecular Weight PAHs(LMW-PAHs),bioconcentration,sedimentation ,solubilization and biodegradation(2)..The results of this study indicated that the drinking water treatment processes play essential role in removing of detectable levels of PAHs from raw water (water source)(Table1 and 2) .The effectiveness of Drinking Water Treatment Plant(DWTP)in removing of organic compounds as PAHs depending upon several factors including quality of water source (16), the type and mode of operation of each treatment process and physiochemical properties of PAHs compound themselves (17,18).The results reffered to the completely removing of most compounds in drinking water or finished water ,however the concentration of some PAHs decrease by one process and increace in the followed step in all three DWT plants (Efraz 1,2 and 3) that depent on the effieciency of each process for removing (effieciency of operation) .There are two major sources of PAHs in drinking or tap water ,contamination of raw water supplies from natural and man-made sources and leachate from coal tar and asphalt linings in water storage tanks and distribution lines,therefore the presence of PAHs in water may from PAH-containing material in water storage and distribution system(19,20)).The main processes in DWTP include addition of Chlorine,polymer,and alum in flash mixer for coagulation and increasing the adsorption of suspended organic particulates to be settled ; Clarification or sedimentation that will reduce the remining suspended particulates to be delivered to sludge bed ;filtreation (filter units or system) ; injection of chlorine before finishing the treatment of water .This may be a method of ensuring the bacteriological quality and controlling disease .as appear from the results that each process had a role in redusing the PAHs level in drinking water to non affected levels.There are several factors in removing of PAHs from water.the main mechanism include the oxidation of some PAHs as fluoranthene and pyrene were due to the oxidation with chlorine (9,21).The results reffered to the non significant variation in concentration of PAHs compounds among the three treatment plants (Efraz,1,2,3).This may due to the same water source of drinking water and expose to the similar sources of PAHs and the effieciency of the operation of each treatment process .The results reffered to the fluctuation in the concentration of some PAHs compounds

during the period of study and high values were recorded during june 2008 .this may be due to increace of atmospheric deposition to source water during that time(2,22) .also the water flow may affected the leval of PAHs in water (1).The concentration of PAHs exceeding 10 µg/L was considered to be heavily contaminated (WHO,1998)(23).the results reffered to the values of total PAHs in source water between (0.150-1.43 µg/L), (0.081-1.462µg/L) and (0.080-0.0941) were recorded at Efraz 1, 2 and 3 during June 2008 in source water and during April 2009 in tap water respectively.this reffered to non contaminated water. In general ,the most samples of surface water contain individual PAHs at level of up to 0.05 µg/L but high polluted water had concentration of up 6 µg/L .As related with the individual PAHs in finished water ,some PAHs as Chry,Flur, BbF,BkF,BaP,DbA,BghiP and IND were detected in low levels ,however the DWTP should be monitored because of the carcinogenic properties of these cmpounds .BaP considered to be probable human carcinogen .according to the USEPA,2007(24),should not be present in the concentration above 0.2 µg/L as maximum contaminant level(MCL).Some Physiochemical properties of Water under study were also determined (table 4) and within the standard range .

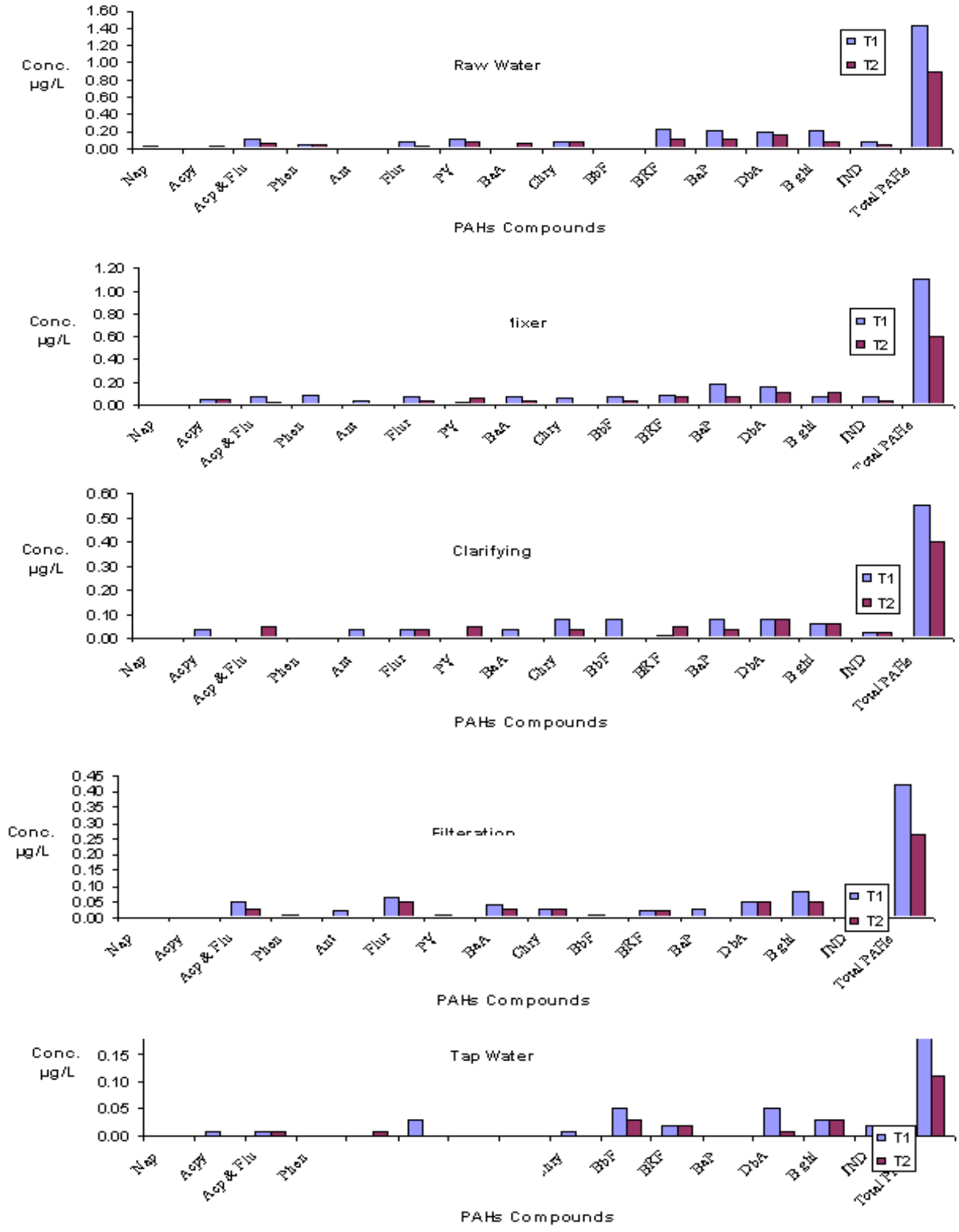
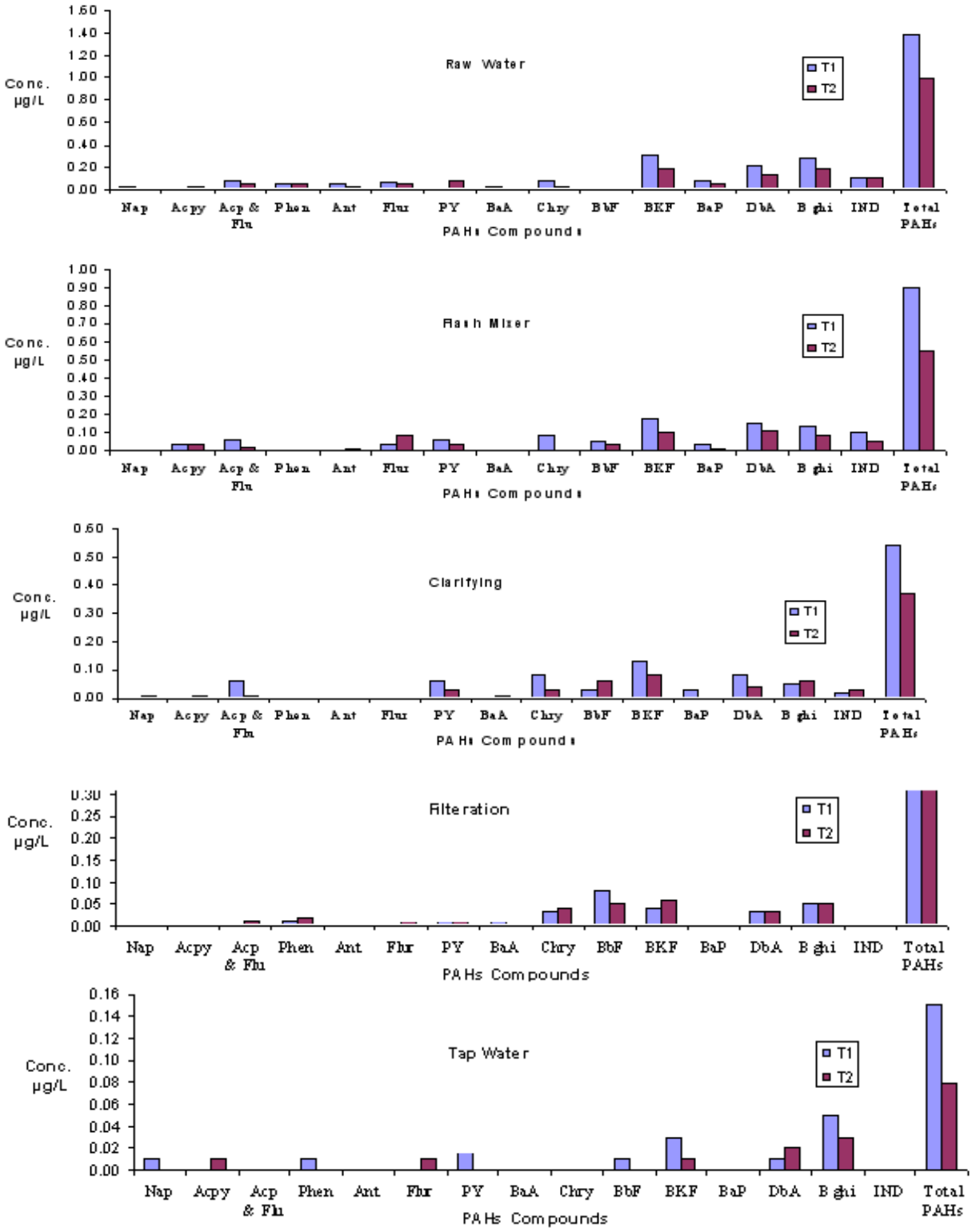
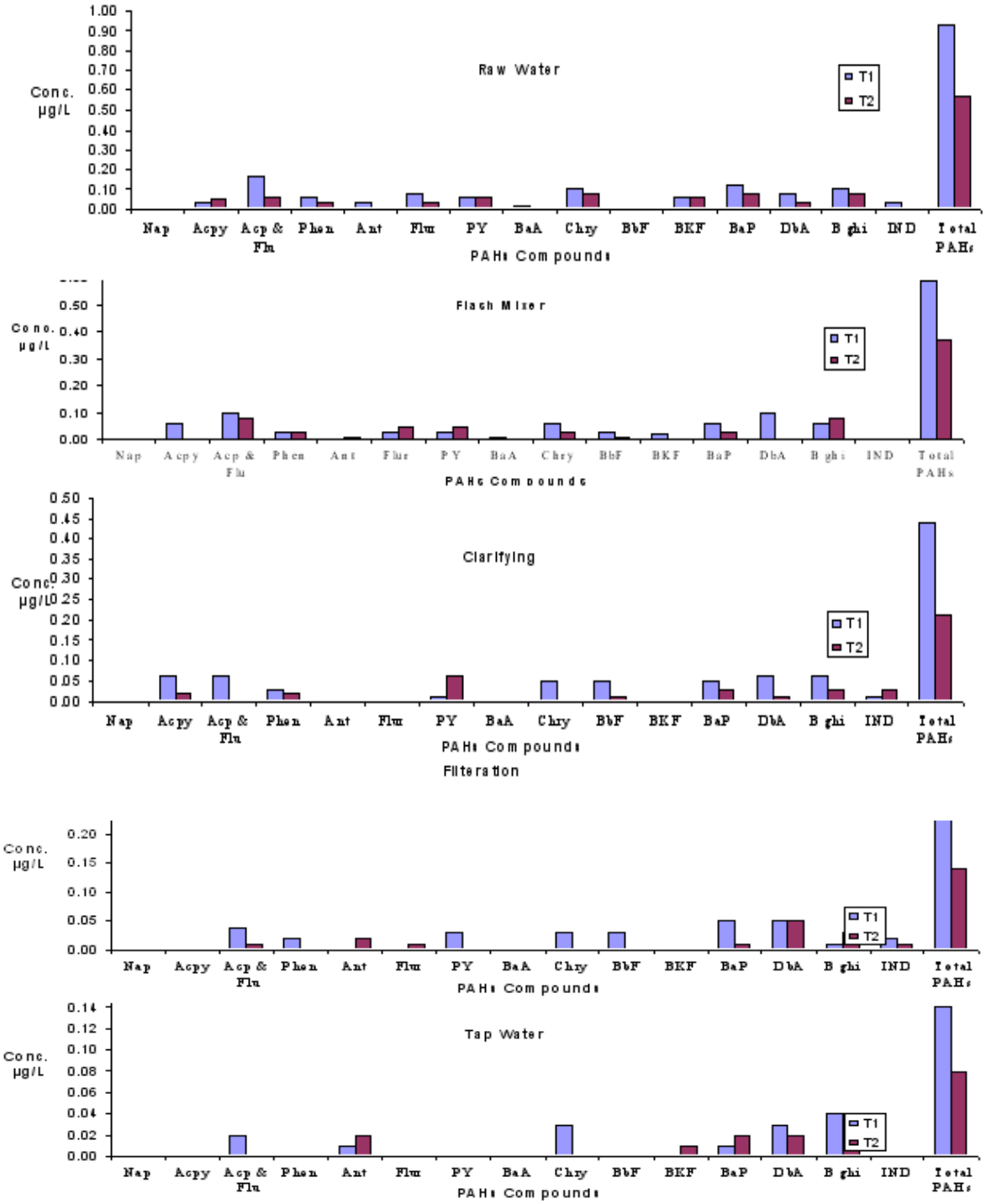


Figure (1) Mean Con. of PAHs Compounds in Drinking water treatment plant DWTP (Efraz 1) during T1 and T2



Figure(2) Mean Con. of PAHs Compounds in Drinking water treatment plant DWTP(Efraz 2) during T1 and T2



Figure(3) Mean Con. of PAHs Compounds in Drinking water treatment plant DWTP(Efraz3)during T1 and T2

Table(1):Removing percentage of PAHs compounds in drinking water treatment plants (Efraz 1,2,3)during the study period

	Flash mixer		Clarifying		Filteration		Tap water	
	T1	T2	T1	T2	T1	T2	T1	T2
Efraz 1								
NaP	-	-	-	-	-	-	-	-
Acpy	100%		%٢٥	100%			100%	100%
Acp &Flu	27%	67%	100%	-	-	%٤٠	%%٤٠	%٦٧
Phen	-	%١٠٠	-		-	-	100%	100%
Ant		-	-	-	%٣٣	-	%١٠٠	-
Flur	62%	-	50%	-	-	-	62%	100%
Py	%٨٣	37%	100%	-	-	100%	-	-
BaA	-	%٥٠	%٥٠	%١٠٠	-	-	100%	%١٠٠
Chry	%٣٧	%١٠٠	-	-	%٦٣	-	%٨٧	100%
BbF	-	-	%٨٣	%١٠٠	-	-	-	-
BkF	61%	27%	11%	%٣٧	%٧٥	%٦٠	%%٩١	%٨٢
BaP	14%	27%	56%	62%	62%	100%	100%	100%
DbA	%11	33%	50%	27%	37%	37%	72%	94%
BghiP	71%	-	-	%45	-	%١٧	%٨٦	%٦٢
IND	-	%٤٠	%٧٥	%٣٣	%٥٠	%١٠٠	%٧٥	%١٠٠
Total PAHs	23%	32%	50%	31%	23%	%٨3	%٨٤	83%
Efraz 2								
NaP	-	100%	-	-	-	100%	50%	
Acpy	-	-	100%	67%	-	100%	100%	-
Acp &Flu	25%	60%	-	50%	100%	-	100%	100%
Phen	100%	100%	-	-	-	-	80%	100%
Ant	100%	67%	-	100%	-	-	100%	100%
Flur	57%	-	100%	-	-	-	100%	83%
Py	40%	63%	-	-	17%	-	70%	100%
BaA	100%	100%	-	-	-	100%	100%	100%
Chry	-	100%	-	-	63%	-	100%	100%
BbF	-	-	40%	-		-	-	-
BkF	42%	44%	28%	%٢٠	69%	25%	90%	94%
BaP	%٦٣	83%		%١٠٠	%١٠٠		%١٠٠	%١٠٠
DbA	%٢٩	15%	47%	64%	63%	25%	95%	84%
BghiP	%٥٤	%٥٦	%٦٢	%٢٥		%١٧	%٨٢	%٨٣
IND	-	50%	80%	40%	100%	100%	100%	100%
Total PAHs	39%	44%	40%	33%	41%	8%	90%	92%
Efraz3								
NaP	-	-	-	-	-	-	-	-
Acpy	-	100%	-	-	100%	100%	100%	100%
Acp &Flu	41%	-	40%	100%	33%	-	88%	100%
Phen	40%	25%	-	33%	33%	100%	100%	100%
Ant	100%	-	-	100%	-	-	67%	-
Flur	62%	-	100%	100%	-	-	100%	100%
Py	40%	17%	67%	-	-	100%	100%	100%
BaA	-	-	100%	-	-	-	100%	-
Chry	40%	62%	17%	100%	40%	-	70%	100%
BbF	-	-	-	-	40%	100%	-	-
BkF	67%	100%	100%	-	-	-	100%	83%
BaP	%٥٠	63%	17%	-	-	67%	92%	75%
DbA	-	100%	40%	-	17%	-	62%	33%
BghiP	40%	-	-	63%	83%	-	60%	88%
IND	100%	-	-	-	-	67%	100%	-
Total PAHs	37%	42%	19%	36%	42%	33%	85 %	86%

Table(2) :The range and Mean±S.D.of PAHs compound recorded at DWTP(Efraz 1,2,3)during the study period

PAHs compounds	Efraz 1(E1)	Efraz 2(E2)	Efraz 3(E3)
Naphthalene(NaP)	ND-0.031 0.003± 0.009	ND-0.022 0.004±0.007	ND 0.000±0.0000
Acenaphthalene(AcpY)	ND-0.043 0.016±0.017	ND-0.031 0.012±0.013	ND-0.060 0.022±0.026
Acenaphthene& Flurene(AcP & Flu)	ND-0.111 0.042±0.035	ND-0.081 0.029±0.030	ND-0.174 0.054±0.053
Phenanthrene(phen)	ND-0.09 0.020±0.032	ND-0.053 0.014±0.020	ND-0.063 0.023±0.0195
Anthracene(Ant)	ND-0.033 0.011±0.0129	ND-0.06 0.010±0.0200	ND-0.031 0.009±0.0110
Flouranthene(Flur)	ND-0.081 0.043±0.0250	ND-0.081 0.028±0.032	ND-0.08 0.0200±0.027
Pyrene(Py)	ND-0.121	ND-0.101	ND-0.061
Benzo(a)Anthracene(BaA)	ND-0.081	ND-0.0301	ND-0.011
Chrycene(Chry)	ND-0.081 0.039±0.0321	ND-0.080 0.029±0.0310	ND-0.101 0.038±0.035
Benzo(b)Flouranthene(BbF)	ND-0.063 0.019±0.022	ND-0.081 0.031±0.028	ND-0.051 0.014±0.017
Benzo(k)Flouranthene(BkF)	0.021-0.233 0.072±0.065	0.011-0.313 0.112±0.025	ND-0.060 0.015±0.026
Benzo(a)Pyrene(BaP)	ND-0.210 0.072±0.0755	ND-0.080 0.021±0.029	0.013-0.123 0.046±0.034
Dibenzo(a,h)anthracene	0.051-0.181 0.097±0.052	0.010-0.211 0.081±0.067	ND-0.102 0.043±0.031
Benzo(ghi)Perylene(BghiP)	0.03-0.211 0.077±0.053	0.03-0.280 0.096±0.079	0.010-0.100 0.050±0.031
Indeno(1,2,3-cd)Pyrene(IND)	ND-0.083 0.031±0.031	ND-0.103 0.039±0.045	ND-0.031 0.010±0.012
Total PAHs	0.150-1.432 0.607±0.415	0.081-1.462 0.570±0.428	0.080-0.941 0.405±0.300

Table(4):Some physiochemical properties of water samples at DWTPs (Efraz 1,2,3)

Point		Water source		Flash mixer		Sedimentation (Clarifying)		Filteration		Tap water	
Properties		T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
pH	E1	8.11	8.23	7.16	8.1	7.34	8.09	7.5	8.08	7.39	8.11
	E2	8.43	8.11	7.78	7.84	7.8	7.79	7.87	7.81	7.53	7.59
	E3	8.03	7.08	7.6	7.81	7.62	7.81	7.73	7.93	7.62	7.85
E.C.	E1	447	392	471	390	456	386	456	389	460	392
	E2	440	373	459	402	455	393	457	395	460	401
	E3	451	394	453	382	452	383	451	387	455	385
Alkalinity	E1	113	190	120	182	98	174	92	178	104	168
	E2	117	166	126	170	109	190	107	186	116	178
	E3	120	194	136	170	138	192	110	176	140	170
Hardness	E1	221	240	206	232	227	292	186	260	211	224
	E2	186	200	174	244	178	212	178	202	180	240
	E3	194	284	192	220	208	244	228	260	182	240
Calcium hardness	E1	90	134	98	140	84	136	90	148	92	112
	E2	102	120	114	116	106	110	104	128	114	184
	E3	118	160	130	162	118	140	116	164	126	186
Dissolved Oxygen	E1	7.0	9.7	6.4	10	7.6	10.8	6.8	11.2	8	10.8
	E2	7.8	10.9	7.0	11	7.4	11	7.2	10.4	8.2	10.1
	E3	7.2	10.4	6.0	10.3	7.6	10	3.2	12.8	6	12
BOD5	E1	1.9	0.7	0.4	0.4	2.4	0.9	1.6	0.4	0.4	0.8
	E2	1.9	0.9	0.5	0.6	2.0	0.9	1.2	0.6	0.2	0.3
	E3	2.2	0.4	0.4	0.6	2.6	4.0	2.4	2.4	0.0	1.3
CL-	E1	17.3	16	17.6	20	21.1	16	18.1	16	18.1	16
	E2	16.6	16	18	18	22.3	16	16.0	18	25.3	24
	E3	18.1	16	18.8	22	21.0	20	18	18	23	20

Table(3):The Mean concentration of PAHs compounds by ring at the DWTPs (Efraz 1,2,3)

PAHs Com.	Raw water (source)		Flash mixer		clarifying		filteration		Tap wate	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Water treatment plant station 1(Efraz 1)										
2-ring	0.04	0.03	0.04	0.04	0.03	0.0r	0.0	0.0	0.01	0.0
3-ring	0.18	0.11	0.2	0.02	0.03	0.05	0.08	0.03	0.01	0.0
4-ring	0.30	0.25	0.23	0.11	0.16	0.11	0.14	0.11	0.04	0.0
5-ring	0.62	0.38	0.49	0.30	0.25	0.16	0.11	0.07	0.12	0.06
6-ring	0.39	0.13	0.14	0.14	0.08	0.08	0.09	0.05	0.05	0.03
Water treatment plant station 2 (Efraz 2)										
2-ring	0.03	0.03	0.03	0.03	0.0	0.02	0.0	0.0	0.01	0.01
3-ring	0.19	0.13	0.06	0.03	0.06	0.01	0.01	0.03	0.01	0.0
4-ring	0.27	0.18	0.17	0.11	0.25	0.07	0.11	0.12	0.13	0.01
5-ring	0.60	0.37	0.41	0.25	0.27	0.18	0.15	0.14	0.05	0.03
6-ring	0.38	0.19	0.23	0.13	0.07	0.08	0.05	0.05	0.05	0.03
Water treatment plant station 3 (Efraz 3)										
2-ring	0.03	0.05	0.06	0.0	0.06	0.02	0.0	0.0	0.0	0.0
3-ring	0.26	0.10	0.13	0.12	0.09	0.02	0.06	0.03	0.03	0.02
4-ring	0.35	0.17	0.13	0.13	0.06	0.06	0.06	0.01	0.03	0.0
5-ring	0.24	0.17	0.21	0.04	0.16	0.05	0.13	0.06	0.04	0.05
6-ring	0.13	0.08	0.06	0.08	0.07	0.06	0.03	0.04	0.04	0.01

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كفاءة عمليات معالجة مياه الشرب في ازالة بعض مركبات ال PAHs من المياه في مدينة اربيل - العراق

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الخلاصة

جمعت نماذج مياه لكل مرحلة معالجة في محطات معالجة مياه الشرب (DWTPs) في مدينة اربيل لدراسة ستة عشر مركبا من مركبات ال PAHs المدرجة ضمن قائمة الملوثات الاولية من قبل وكالة حماية البيئة USEPA وتقدير كفاءة كل عملية في ازالة مركبات ال PAHs . سجلت اعلى قيمة (0.313 µg/L و 0.233 µg/L) للمركب Benzo(k)flouranthene في المحطة DWTP1 و DWTP2 (Efraz 1 و Efraz 2) حزيران ٢٠٠٨ في ماء المصدر , بينما سجلت اعلى قيمة 0.174 µg/L للمركب Acenaphtheen و Flourene خلال حزيران ٢٠٠٨ لمياه المصدر في المحطة الثالثة Efraz3 . لم تسجل قيم لمركبات ال PAHs ذات الاوزان الجزيئية الواطئة خلال فترة الدراسة لبعض مراحل معالجة المياه في الحطات DWTPs.تشير القيم الواطئة في مياه الحنفية (المياه المعالجة) الى كفاءة عمليات المعلجة في ازالة مركبات ال PAHs من ماء المصدر . تراوحت معدل تركيز مركبات ال PAHs الكلية بين (0.081-1.462µg/L) , (0.150-1.43 µg/L)و(0.080-0.0941) والتي سجلت في المحطه ١ , ٢ و ٣ خلال حزيران ٢٠٠٨ و نيسان ٢٠٠٩ في ماء المصدر و ماء الحنفية على التوالي.كانت النسبة المئوية لازالة مركبات ال PAHs الكلية (84%,90% and 85%) و(83%,92% and 86%) والتي سجلت في Efraz ١ , ٢ و ٣ خلال حزيران ٢٠٠٨ و نيسان ٢٠٠٩ على التوالي . سجلت القيم العالية لمركبات ال PAHs خماسية الحلقة (BbF,BkF.BaP,DBA) في المحطة Efraz 1 و Efraz 2 ومركبات ال PAHs رباعية الحلقة (Flur,Py,BaA and chry) في Efraz 3 .