

Effects of Rustamiyah treatment plant effluent on concentration of some heavy metals in water and sediment of Diyala river

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Abstract

Concentrations of four heavy metals, Zinc , Copper , Lead and Cadimium were determed in water and sediment samples collected bi-weekly from six sampling sites on the lower part of River Diyala during low flow period (August to October) and high flow period (April to June). A reference point site (1) was situated upstream the effects of the effluent. Present work describes the effect of Rustamiya waste water treatment plant on heavy metals in water and sediment of River Diyala. The results indicated that heavy metals level were higher in low flow period of water compared with high flow period. Pb concentration was high in treatment effluent site compared with mixing zone and reference point. Cd level in low flow period in water was high and affected by the effluent disposal from the treatment plant. Concentration of heavy metals in sediment showed simple difference between both periods in refrence point and mixing zone. Average Cu concentration in the sediment for two periods was high in mixing zone compared with other metals.

Introduction

During the past 50 years, environmental levels of heavy metals have increased in the aquatic environmental (1). Impact of heavy metals wastes disposed into river may be assessed through increased levels in water, sediment or bioa, in some cases concentration of heavy metals reach harmful level to the ecosystems (1). In surface water the concentration of various elements may be increased beyond their natural levels due to release of industrial, agricultural, domestic and other wastes, thought, some elements are mainly available in dissolved forms, the major part and especially the heavy metals may be bound to small silt and clay particles also organics higher EC. Sevrал authors have studied the heavy metals content of various marine and river sediment in relation to water pollution (2-10). In Iraq several works have considered the acute pollution problems in lower reaches of Dyala river (11-14). The aim of this study was to assess the effect of the Rustamiyah wastewater treatment plant on the concentration of heavy metals in Diyala river. The present work is a part of a

comprehensive program to evaluate a large number of different organic, inorganic, salts and heavy pollutants in area of a sewage treatment plant discharging into the Diyala river.

Material and methods

The study Area

Rustamiyah treatment plant is located on the right bank River Diyala 15km prior to reaching River Tigris south of Baghdad Figure(1), Diyala river is one of the important rivers in Iraq, the flow rate ranges between 5m/sec and 150m/sec(14) the discharging point of the treatment plant is 4km below the new Diyala bridge, 7 km above the old Diyala bridge.

Sampling and analysis

Water samples were collected during two periods low and high flow periods of the year, the high flow period (HEP) covers April, May and June, while the low flow period (LFP) covers August, September, October and November. One sample per station per month was collected from 6 stations and analysed for Cd, Cu, Zn and Pb concentration in the river water and sediment of the river bed. A boat was used in the collection of the samples 30 cm below the water surface for the river water and from the river bed for the sediment samples. Sediment samples at reference point were not included because of the shallow water depth and high flow rate so the concentrations will be normal or lower than the others station. The first sampling station site D1 was 0.5 km upstream the treatment plant discharging point and was considered as a reference point. Site D2 was in the River Diyala just below the discharging point. Site D3 and D4 were 1 km 2 km downstream treatment plant. Site D5 and D6 were 2 km and 3 km below the treatment plant. According to procedures mentioned in standard method for examination of water and wastewater(15) A Pye Unicam Sp9 flame atomic absorption spectrometer was used to determine the concentration of heavy metals.

Water samples were prepared according to nitric-perchloric acids digestion method(15) while sediment samples were prepared by nitric-perchloric-hydrochloric acids digestion method(16).

Result and Discussion

Heavy concentrations (ppm) in the reference point, mixing zone, and the treatment plant at the two periods, were presented in table(1).

Results showed no significant differences in concentrations among stations within each period, Hence, a comparison was made between the concentrations of heavy metals in the reference point, the treatment plant effluent and the mixing zone stations 2,3,4,5 and 6. A reference point, the treatment plant effluent and the mixing zone at the two periods are shown in table1. The percentage of increases or decreases in

heavy metals concentrations at reference point , mixing zone and treatment plant effluent is summarized in table(2).

Heavy metals increase in the water was 63,2% - 261% from reference point to mixing zone during LFP as compared to a range of 138% - 670% increase during HFP table(2) . On the other hand these parameters showed a decrease of 29.2% - 144% at the mixing zone as compared to the treatment plant effluent during HFP. Cu concentration was increased by 262% during LFP from the treatment plant to the mixing zone which was due to Cu low concentration in the treatment plant effluent at this period table(1). A decrease of 12.7 - 38.7 was observed in Zn and Pb concentration seemed to be initially high in River Diyala prior reaching the mixing zone and a reduction of 49% and 92% was observed during LEP and HFP in its concentration at a mixing zone as compared to reference point. Cadmium concentration in mixing zone as compared to treatment plant effluent was also reduced by 84.1% and 89.3% during LEP and HFP respectively.

Table(3) shows heavy metals concentrations in River Diyala were within the permissible level of raw surface water (18). Except Pb and Cd which exceed the permissible limits of 0.05ppm and 0.005ppm respectively.

Figure(2) shows the variation of heavy metals in sediment for the two periods. The Cu concentration in the sediment of the river bed at the mixing zone was the highest and decreased for the Zn, Pb and Cd respectively. Average Cu concentration in the sediment for the two periods varied between 100 and 10ppm for all stations at the mixing zone. On the other hand, Cd average concentration varied between 0.02 and 0.2ppm.

Heavy metals concentrations in the sediment were high in the mixing zone bed especially during LEP. Several authors were observed that phosphate and Iron hydroxides played a key role in the trapping of heavy metals such as Pb, Cd and Zn (17). This phenomenon, in addition to the fact that high flow in the river, was either diluting the sediment material by adding more sediment, or washing out the bed material. However, the dynamics of sedimentation should be investigated more in a comprehensive research programme.

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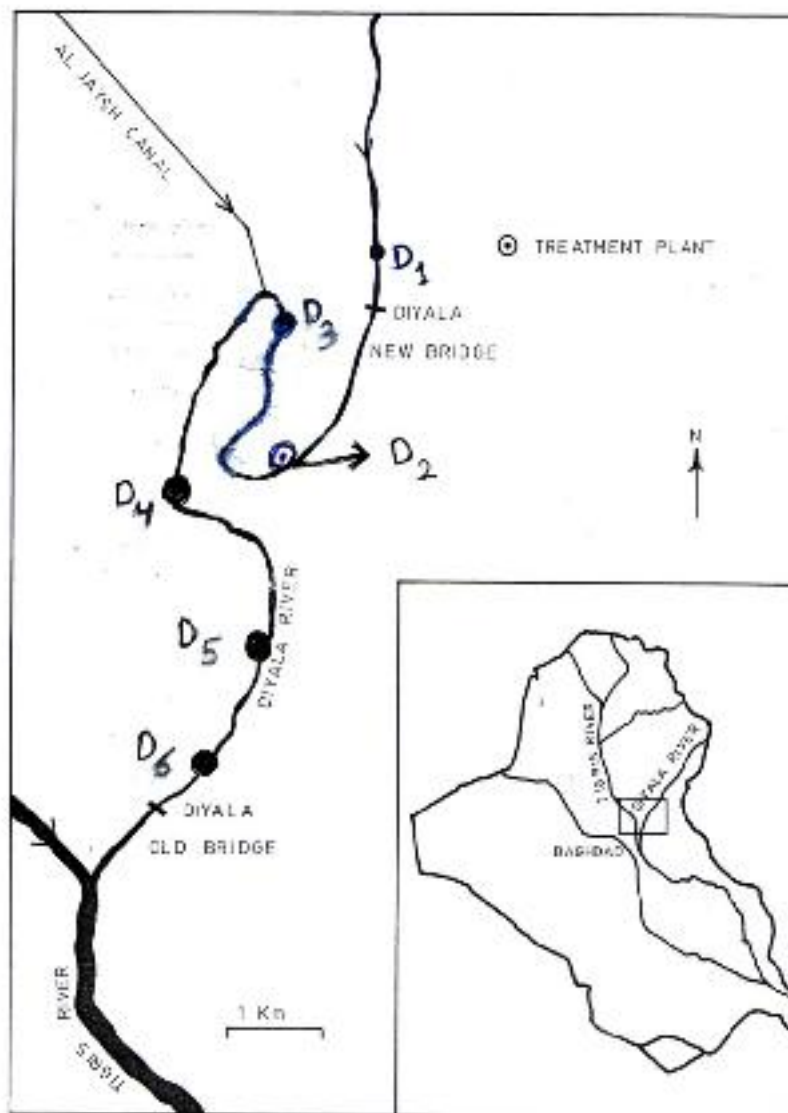


FIG. 1. LOCATION OF SAMPLING STATIONS

Table (1) Heavy metals concentrations (ppm) in the Reference point, mixing zone and the treatment plant effluent at the two periods (ppm)

Parameters	Low Flow Period				High Flow Period			
	Conc. at ref. Sta. 1	Mixing zone conc.	Stat. No.	Conc. in total Effluent plant	Conc. at ref. sta.	Mixing zone conc.	Stat. No.	Conc. in total plant effluent
Cd	0.0015	0.007	3	0.0048	0.0070	0.0070	3	0.0048
Cu	0.0098	0.0160	3	0.0044	0.0030	0.0080	3	0.0127
Zn	0.0350	0.0580	4	0.0660	0.0180	0.0440	3	0.0180
Pb	0.0166	0.0630	3	0.0980	0.0545	0.0420	3	0.03240

Table (2) Increase or Decrease Percent in Heavy Metals Concentrations at Reference Point, Mixing Zone and Treatment plant Effluent (ppm)

Parameters	Low flow period % Increase or Decrease (+ or -)		High flow period % Increase or Decrease (+ or -)	
	Ref. point to Point at Mixing zone	Effluent to Point at Mixing zone	Ref. point to Point at Mixing zone	Effluent to Point at Mixing zone
Cd	49.00	84.16	91.92	89.77
Cu	65.26	262.00	198.00	-29.29
Zn	65.71	-12.78	138.00	-144.00
Pb	261.00	-38.77	670.00	29.63

Table (3) Iraqi Standards for some of Heavy Metals Conc(ppm) Discharged Effluents and Recovery Water Bodies (18)

Parameters	Effluent Discharged in to stream (Max. Conc/rang)	Stream Water (Max. Conc/rang)
Cd	0.01	0.005
Cu	0.20	0.050
Zn	2.00	0.500
Pb	0.10	0.050

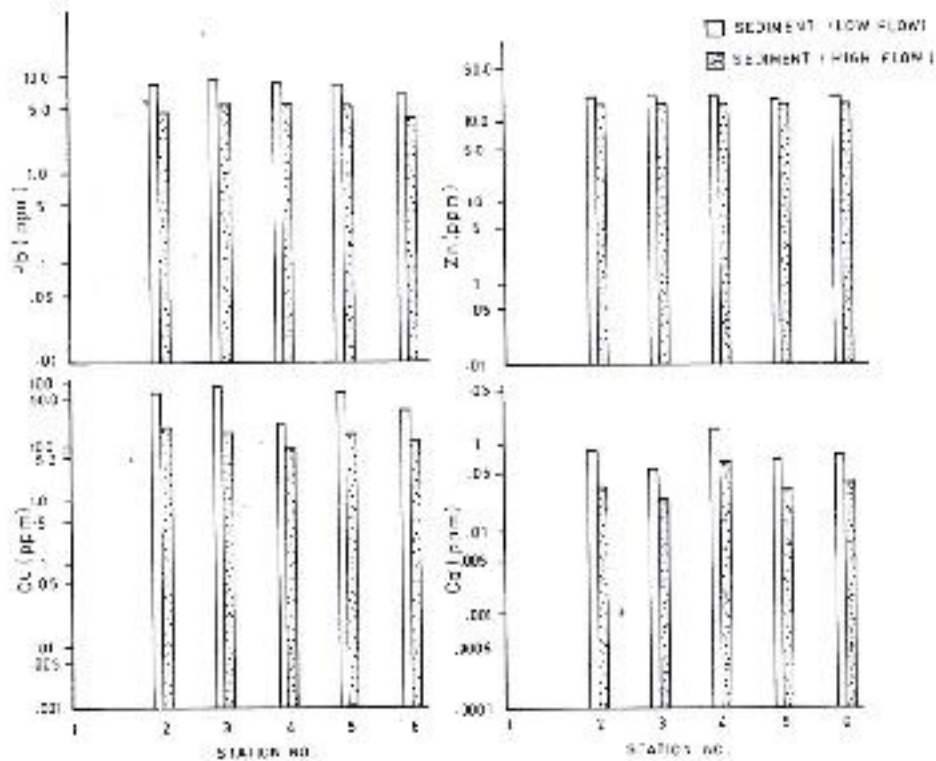


FIG. 2. CONCENTRATION VARIATION OF HEAVY METAL IN SEDIMENT
OF THE MIXING ZONE:

تأثير المياه المصرفه من مشروع المعالجه في الرستميہ على تراكيز بعض العناصر الثقيله في مياه و رسوبيات نهر ديالى

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الخلاصہ

تمت دراسه تراكيز العناصر الثقيله وهي الكاديوم ،الخاصين ،النحاس و الرصاص في مياه و رسوبيات عدہ مواقع على نهر ديالى بالقرب من مشروع الرستميہ لمعالجه المياه الثقيله. تم جمع النماذج لموسم انخفاض مناسيب المياه (شهر اب لغايہ شهر تشرين الثاني) و موسم ارتفاع مناسيب المياه (شهر نيسان لغايہ شهر تموز) و بمعدل مرتين في الاسبوع و لمده سنتين. موقع رقم (1) اعتمد كمصدر للمقارنہ والذي يقع اعلى من نقطه تصريف المشروع. تهدف هذا الدراسه لمعرفه تأثير تراكيز هذه العناصر المصرفه من مشروع الرستميہ على تراكيزها في مياه و رسوبيات النهر .

اظهرت النتائج ان مستويات العناصر الثقيله في الماء كانت في فتره انخفاض مناسيب المياه عاليه مقارنہ بفره ارتفاع المناسيب. فقد كان تركيز الرصاص عاليا في منطقه التصريف مقارنہ بمنطقة المزج و المصدر في فتره انخفاض المناسيب . اما مستوى الكاديوم في الماء و خلال فتره انخفاض المناسيب كان مرتفعا و لم يتاثر بتصريف مياه المشروع .

اما بالنسبه للرسوبيات فاوضحت النتائج ان هنالك فروقا بسيطه بين موسمين وبين نقطه التصريف و منطقه المزج حيث كان معدل تراكيز النحاس ولفترتين عاليا في منطقه المزج مقارنہ ببقية العناصر .