Comparative Study on Heavy Elements Released From Industry in Old-And New Industrial Areas by Cairo

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ABSTRACT

Heavy elements (pollutants) released from industry in a new city (6th October city) were estimated and compared with those released from a traditional industrial areas (Shobra El-Khaima). Water samples were periodically collected from the studied areas every three months for a period of one year. The samples were treated according to the standard operation procedure, digested and analyzed using an atomic absorption spectrophotometer. Cadmium, nickel, lead cobalt and chromium were estimated in the treated samples. The results indicated that, while the amount of released Cd, Pb and Co were reduced to the half amount in the new industrial area, the amounts released of Ni increased by about 1/3 and that of Cr was doubled. The results were discussed and recommendations were suggested to minimize the released pollutants to keep environment as clean as possible.

Key Words: Heavy elements / Industrial areas / Cairo.

INTRODUCTION

The pollution problem starts with the discharge of the untreated industrial effluents, domestic wastes and pesticides into the environment [1]. Where, environmental pollution conventionally refers to biological, chemical and physical substances introduced largely as a result of human activities [2].

In the last few years, industries increased their productions and with little improvement of their emission control systems and urban expansion resulted in new communities (as 6th October city). With increasing industrialization in Egypt, huge quantities of industrial waste water have been discharged into the river Nile and its branches without any treatment in old industrial zone as Shobra El-Khaima. So, toxic elements in industrial waste water especially heavy metals have a pronounced direct effect on human health and have an accumulative effect on aquatic livings [3]. Efforts have been processed to minimize environmental hazards, where the current levels of potentially toxic chemicals and other wastes should be monitored[4].

The present work is devoted to qualitative and quantitative analysis of waste water discharged from industrial activities which is collected the 6th October city and from Shobra El-Khaima site as new and old industrial zones. Also, canal water and the oxidizing pole water of the discharge points at shobra El-Khaima and 6th October zones respectively; are all concerned in this study. Cadmium, lead, nickel and zinc are usually detected in agricultural and industrial liquid wastes [5]. So this work is focused on the analysis and investigation of environmentally hazardous heavy metals including: Cd, Pb, Co, Ni and Cr using atomic absorption spectrometry technique.

EXPERIMENTAL

1) Sampling:

More than30 water samples including industrial waste water, canal water and oxidation basin water samples are collected from 6th October and Shobra El-Khaima cities in a period of

one year from June, 1998 to May, 1999. Samples are collected periodically each 3 months in cleaned and stoppered polyethylene bottles (1.5 L.) and acidified by nitric acid, 65% (2 ml. Conc. HNO3 / L.). Where conc. nitric acid was obtained from Merck, Germany. Stock standards solution used for atomic absorption apparatus are obtained from BDH, England.

Water samples are digested with conc. nitric acid [6]. Preparation of the samples includes the transfer of 50 ml. from each water sample to a glass beaker and the addition of 5 ml. nitric acid (65%) to it, then evaporating these prepared samples on a hot plate to the lowest volume possible approximately 10 ml. each (just prior to the formation of insoluble salts). At this point heating was continued with the addition of nitric acid until clearness. The beaker walls are rinsed with double distilled water followed by filtration of the digest. The filtrate was transferred quantitatively to a 50 ml. volumetric flask and adjusted to a certain volume [7].

2) **Instrumental analysis**:

Digested samples are analyzed using a Flame Atomic Absorption Spectrophotometer (Model 2380, Perkin Elmer), fitted with a deuterium lamp background correction and the appropriate hallow cathode lamps are used for the determination of the studied heavy metals. The source of the flame was an air – acetylene mixture. Air was cleaned and dried by filtration to remove oil, water and other foreign substances. Working standard solutions were prepared by appropriate dilution of stock solution. All measurements were made in triplicate.

RESULTS AND DISCUSSION

1) Analysis of studied water samples from 6th October city:

Waste water samples are collected from 6th October city, as a new industrial city, form the following locations: Oxidation basin, cars factory, chemicals factory, cars condition factory and metal factory. Cd, Pb, Co, Ni and Cr contents have been determined for all water samples collected from these different locations.

Cadmium (Cd):

Cadmium concentration does not exceed than 0.04 ppm for all the analyzed waste water samples. Its maximum content is detected for water sample from cars conditions factory which gives 0.04 ppm. While the lowest Cd content is detected for metal factory which gives 0.01 ppm. It is well observed that metals and chemicals factories waste water samples still have slightly lower Cd content than the cars factory. Also Cd content in waste water sample collected from oxidation basin, does not exceed than 0.04 ppm. While this oxidation basin site is considered as a point for the collection of all industrial waste water drainings in the city, but its Cd content is not so high due to the possible periodically partial water treatment process occurred at this site.

With comparing the data given for Cd content in Figs. (1-4), one could not observe a sensible variation of Cd content for all the studied industries through the duration of this study. Except in metal factory, there is a little decrease in Cd content to 0.01 ppm. at the last period of analysis. Also, there is a little increase in its content to 0.04 ppm. for oxidation basin water sample at the same period of time. The average content of Cd for all water samples collected from all the studied zones is 0.027 ppm.

Lead:

Lead concentration in waste water samples collected from cars factory reaches its maximum value, 0.9 ppm. Also its content in water samples collected from cars condition factory is still so high, 0.7 ppm. That may due to cars industrialization process itself. Which may characterized by its high producing lead contaminants. The data are given in Figs. (2-4). Pb content in wastewater samples collected from cars industry increases gradually from0.7 to

0.9 ppm. through the four periods of this study, that may be attributed to the increasing of industrialization and cars fabrication process itself.

It is well observed that Pb content in wastewater samples collected from metals factory does not exceed than 0.18 ppm. through the four periods of study. Also, it is the lowest pb content for all the studied factories. Lead content in wastewater samples collected from chemicals factory does not exceed 0.5 ppm. The data are given in Fig.(3).

From this interpretation it could be noticed that cars factory may be the main source of Pb pollutant detected in wastewater samples in the area under study. Also, it may be the main reason for the high Pb content in the oxidation basin water samples, 0.7 ppm., through the periods of study. The average Pb content for all water samples collected from all the studied zones is 0.53 ppm.

Cobalt:

Co content in all wastewater samples collected from the metal factory through periods of study is constant, 0.01 ppm. Which are given in Figs.(1-4). This constant value may be attributed to the steady Activity State of metals industrialization metals factory through this period of time. It is well noticed a pronounced decrease in Co content from 0.04 to 0.02 ppm. in wastewater samples collected from cars factory through the whole year of study. The same results are observed for cars industry starting from the second period of study. Also, Co content decreases from 0.03 ppm. in wastewater samples of chemicals factory for the first half of year to 0.01 ppm. in the last half of the year. That may attributed to the decrease in the factory activity itself or to the treatment process of the wastewater effluent before its draining.

Cobalt content in wastewater samples collected from oxidation basin reaches its maximum content, 0.03 ppm. at the second period of study, Fig.(2). Also it reaches its lowest value, 0.02 ppm. for the collected samples at the second half of the year. That may be attributed to the continuous treatment processes which are carried out for the wastewater effluents collected in this site. The average Co content for all water samples collected from all the studied zones reaches 0.025 ppm.

Nickel:

Ni content in the water samples of cars factory is in the range 1.4-1.8 ppm. It is considered the highest heavy element concentration predicted in all water samples for all the studied areas at 6th October City. It may also, refer to the high elemental pollution of nickel produced from the industrial activity of cars fabrication in the studied zones. Ni content in wastewater samples collected from metals factory through the four periods of study ranges from 0.8 to 1.1 ppm. So, metals factory as well as cars factory are considered the main source of Ni pollution which may predicted in the studied area.

Inspite of the maximum Ni content of cars condition factory and chemicals factory are 0.5 and 0.04 ppm. respectively, but its maximum content in the oxidation basin reaches 1.1 ppm. through the periods of study. The relatively high content of Ni in oxidation basin water samples may be attributed to its high release from cars and metals factories in the studied region. The average Ni content for all studied water samples reaches 0.796 ppm.

Chromium:

Cr content in wastewater samples collected from cars factory ranges between 0.08 and 0.1 ppm. It is considered the highest Cr value for all the studied samples. In contrast to that, cars condition and chemicals factories wastewater samples give Cr content in the range 0.02-0.03 ppm. and 0.02-0.04 ppm. respectively. These Cr values are considered the lowest Cr content for all the studied samples in 6th October City. Cr content in the oxidation basin water samples

are in the range 0.05-0.08 ppm. through the four periods of analysis in the present study. The average Cr content for all the studied water samples is 0.052 ppm.

With comparing all the given results, it is clear that the cars factory could be considered the main source of Ni elemental pollution predicted in the studied area at 6th October city. Also, metals factory could share with a part in this elemental pollution of Ni in the studied zone. Also, cars factory in addition to the cars condition factory may be the main source of Pb elemental pollution that could be predicted in the studied region. So, the increase of Ni, Pb and Cr content detected in the studied area could be mainly a result of cars factory activity which may be a main source of an environmental pollution in the studied area.

2) Analysis of studied water samples from Shobra El-Khaima:

Wastewater samples are collected from Shobra El-Khaima region as a traditional industrial site. Abu El monage Canal is a branch of river Nile at shobra El-khaima site. First location is from the canal at one Km before the centered industrial area. Second location is from Abu El monaga canal at the focused point for discharging the wastes of the industries at this zone. Third location is from the canal at one Km after the second location.

Cadmium:

Cd content in the three studied locations through the four periods of analysis, does not exceed 0.08 ppm. The average content of Cd from the three locations is 0.065 ppm. This relatively high average Cd content in the studied samples may reflect the relatively high industrial activities in this industrial old zone and the draining of the wastewater effluents without or with a partial treatment.

Lead:

Pb content in water samples collected from location one through the four periods of analysis in the range 0.9-1.2 ppm. While its content for locations two and three is in the range 1.4-1.9 and 0.8-1.4 ppm respectively. Maximum Pb content for water samples of location two is 1.9 ppm., and it is considered the maximum Pb content for all the studied water samples in the three locations. It may refer to the high industrial discharging at location two which may be the main source of Pb release in the studied zone. It also may refer to the Pb contamination could be achieved by the continuous accumulation of its release from the industrial activities in this old industrial region. The average content of Pb for all water samples collected from the three locations is 1.225 ppm.

Cobalt:

Co content in the three locations is in the ranges 0.01-0.02, 0.03-0.05 and 0.02-0.07 ppm. respectively. So its maximum content reaches 0.07 ppm. for water samples collected from location three, and its lowest content reaches 0.01 ppm. for water samples collected from location one, and it is a logic result where industrialization activities are focused at location two. It may refer to the relatively increase of Co pollutants accumulation in location three. The average Co content for all the studied water samples in Shobra El-Khaima industrial area is 0.046 ppm.

Nickel:

Ni average content for all the studied water samples in Shobra El-Khaima industrial area is 0.603 ppm While, the maximum Ni content for the studied water samples collected from the three industrial locations reaches 0.76 ppm. and the lowest value reaches 0.44 ppm.

Chromium:

Maximum Cr content for all the studied samples is 0.04 ppm. While its lowest value reaches 0.01 ppm. The first industrial location has the lowest Cr content, where it ranges from

0.01 to 0.02 ppm. through the four periods of analysis. The average Cr content for all the studied water samples in Shobra El-Khaima industrial area is 0.029 ppm.

3) Comparison between the new and the old studied industrial zones:

With comparing the heavy elements contents from industrial activities in 6th October city as a new industrial city, with that detected from industrial activities in Shobra El-Khaima zone as an old industrial region; one could notice the followings:

Cadmium average content detected in water samples from 6th October industrial area, 0.026 ppm. is about the half of its value detected in Shobra El-Khaima industrial zone, 0.065 ppm. That may attributed to the presence of glasses factories and plastic industries which discharge their effluents into the water canal at Shobra El-Khaima zone. However, these results are six times higher than the standard limits of WHO [8], EEC [9] and standard limits of imposed by the Egyptian law (48/1982).

Lead average content in water samples analyzed from 6th October City reaches 0.538 ppm. which is about the half of its content detected for Shobra El-Khaima industrial waste water samples, 1.225 ppm. that may attributed to the presence of many batteries factories which discharge their effluents into water canal at Shobra El-Khaima zone. However, these average values are about 10 times higher than WHO standards, EEC and Egyptian standard limits for drinking water [10]. Also, these results are 25 times higher than the concentration of lead in water river Nile [10], and 35 times than the concentration of lead in water Nile [11].

Also, The same finding occur for cobalt average content which is reduced from 0.046 ppm. for Shobra El-Khaima water samples to 0.025 ppm for 6th October water samples. This is due to the presence of many glasses factories which discharge their wastes into the water canal at Shobra El-Khaima.

Inspire of the relatively high content of Cd, Pb and Co in the present results, these findings may refer to the success of industrial activities in the 6th October city as a new industrial area in reducing the the release of Cd, Pb and Co pollutants to about the half amount of that for old industrial area.

On the other hand Cr average content for water samples from 6th October city and Shobra El-Khaima reaches 0.052 and 0.029 ppm respectively. So its value in the new industrial zone is about double the value detected for the old industrial region. So, the average concentration obtained in industrial waste water samples from 6th October city is near to the standard limits imposed by the Egyptian law (48/19982); (Cr < 0.05 ppm.).

Also, Ni average content in water samples from the new industrial zone, 0.796 ppm. is about 34% higher than its content detected for water samples from old industrial zone, 0.603 ppm. However, these average values are about 5 times higher than that of the standard limits in law (48/1982). The average elemental contents for all the studied samples are expressed in tables (1&2), and the limit standard values are presented in table (3).

CONCLUSION

From the aforementioned results one could deduce that the new industrial city "6th October" may be one of the best solutions to avoid the accumulation of environmental pollutants produced from old industrial zones within the center of inhabitants aggregation.

Nickel and chromium content in waste water effluents of 6th October industrial area ought to be reduced with continuous treatments of these effluents before draining into the oxidation basin.

Also, the continuous treatment of waste water effluents of industries is strongly recommended for the new industrial zones before draining into oxidation basin to minimize the heavy elements content that might pollute the industrial area. This is also strongly recommended for old industrial zone to avoid the continuous pollutants accumulation in especially in the canal through which the studied industries drains their waste water effluents.

Finally, it is also strongly recommended that most of the factories in the old industrial zones could be transported to a new industrial aggregation zone far away from the inhabitants, to control and minimize the released pollutants to keep environment as clean as possible.

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Table 1: Average concentration (ppm) of some heavy metals at different periods in 6th. October City

Time	Cd	Pb	Co	Ni	Cr
June-1989	0.026	0.49	0.03	0.87	0.04
Sept.-1989	0.027	0.53	0.03	0.79	0.046
Dec.-1989	0.026	0.59	0.02	0.70	0.052
March-1999	0.026	0.52	0.016	0.73	0.05
Total Aver.	0.027	0.53	0.025	0.79	0.052

Table 2: Average concentration (ppm) of some heavy metals at different periods in shobra El-Khaima City

Time	Cd	Pb	Co	Ni	Cr
June-1989	0.07	1.12	0.056	0.61	0.026
Sept.-1989	0.063	1.4	0.057	0.55	0.026
Dec.-1989	0.063	1.4	0.063	0.60	0.03
March-1999	0.063	1.36	0.059	0.64	0.033
Total Aver.	0.065	1.22	0.052	0.60	0.029

Table 3: Values of limited standards.

Limit Standard	Cd	Pb	Co	Ni	Cr
Law 48|1982	0.01	0.05	0.05	0.1	0.05
WHO	0.01	0.05	0.05	0.1	0.5
EEC	0.01	0.05	0.05	0.1	0.05

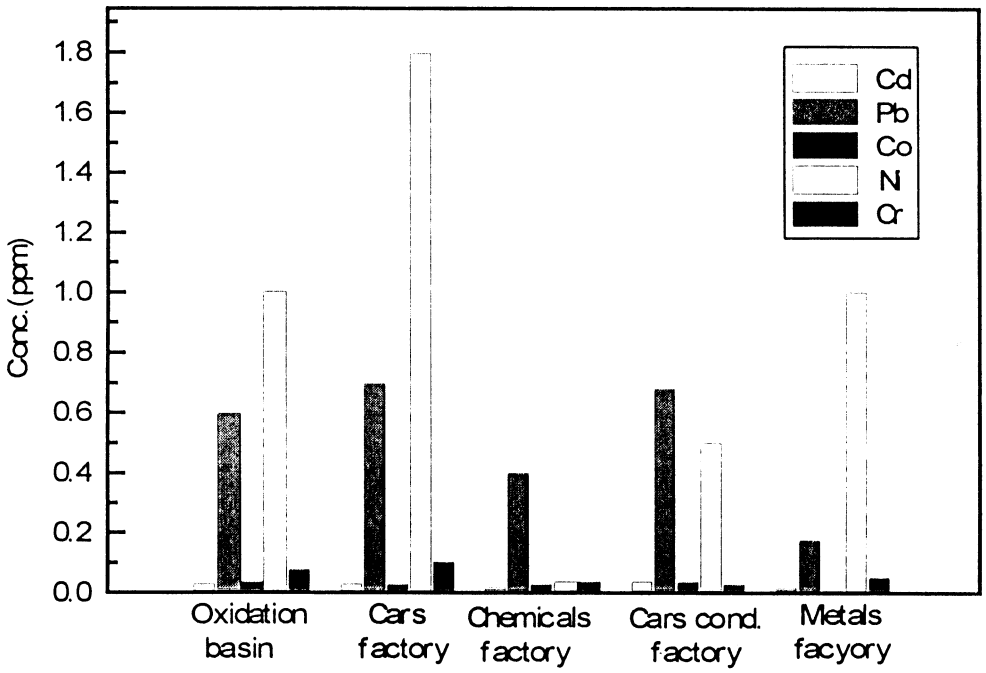

Fig. (1): concentration of some heavy metals in industrial waste water, collected in June 1998, from 6 th October city,

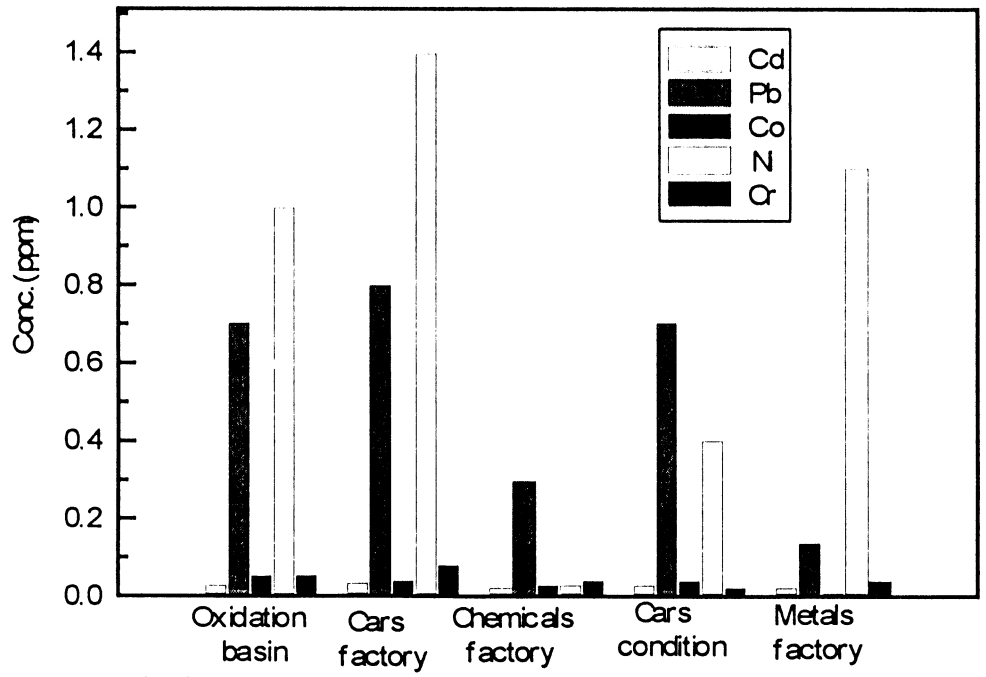

Fig. (2): concentration of some heavy metals in industrial waste water, collected in september 1998, from 6 th October city.

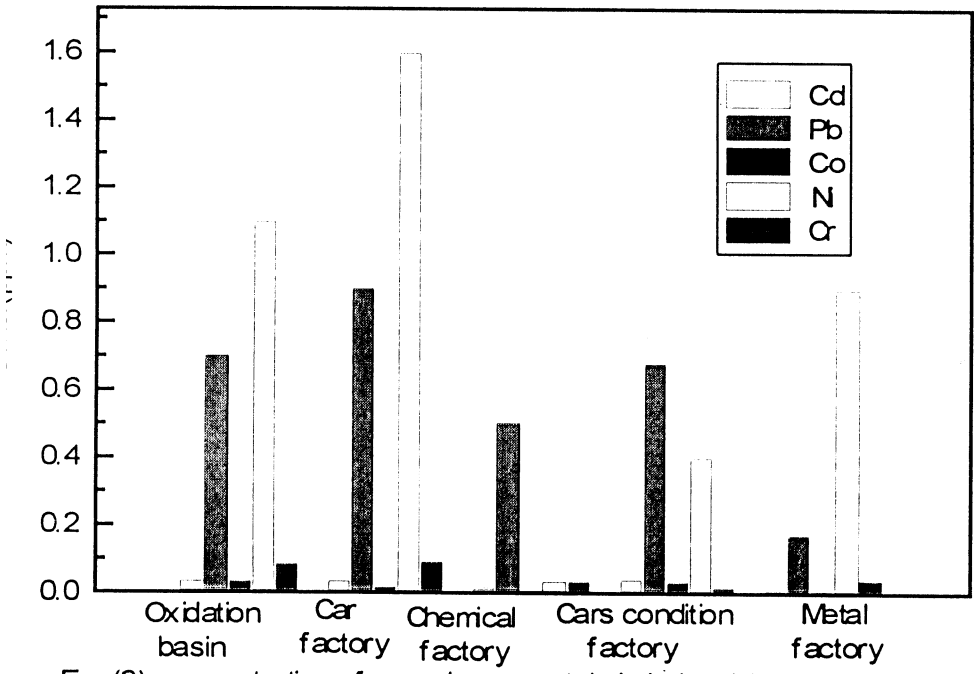

Fig. (3): concentration of some heavy metals in industrial waste water, collected in December 1998, from 6 th October city.

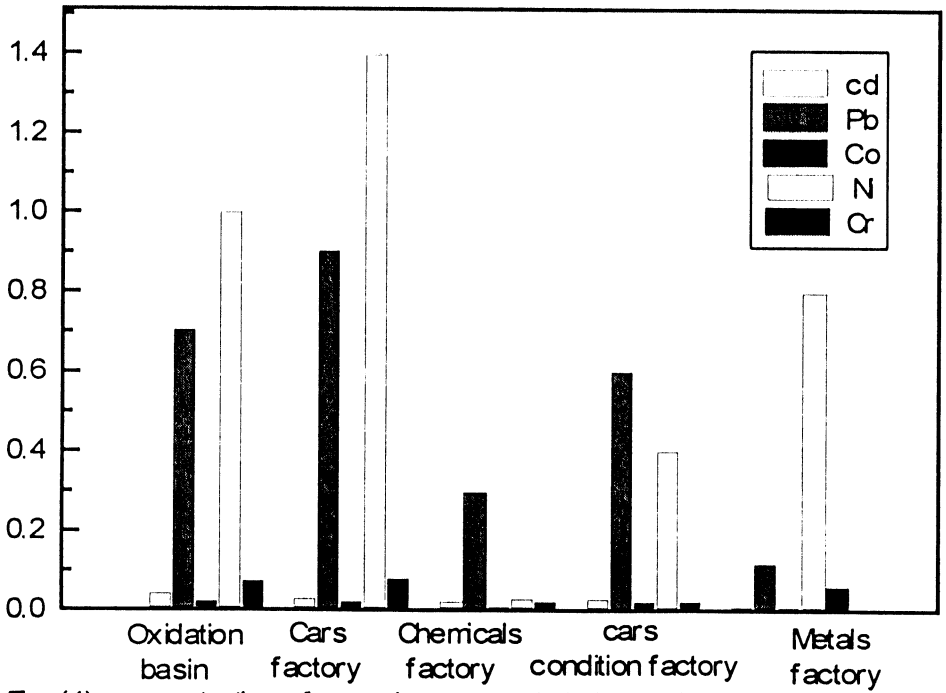

Fig. (4): concentration of some heavy metals in industrial waste water, collected in March 1999, from 6 th October city,

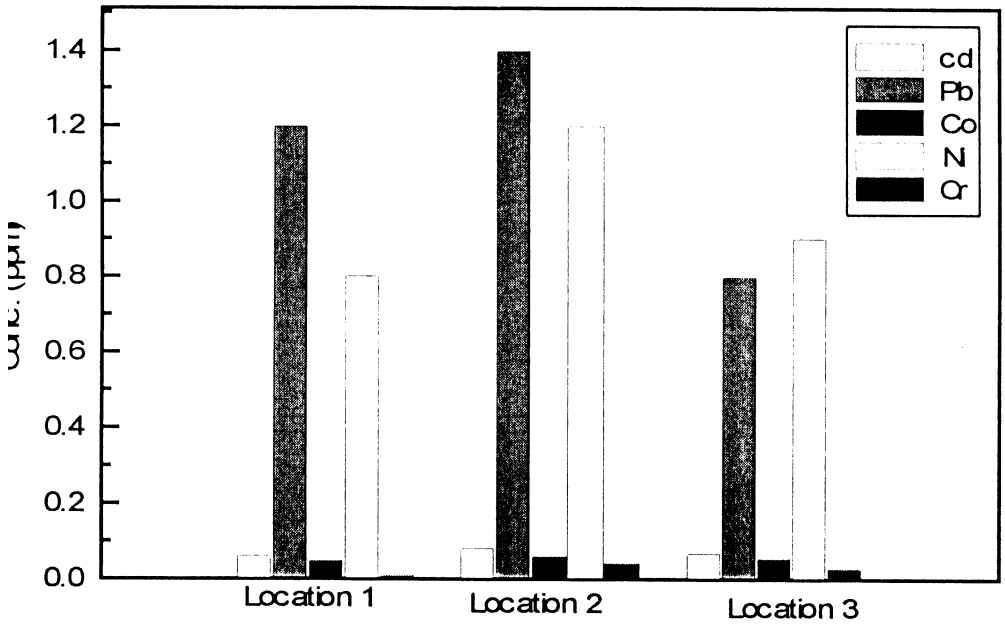

Fig. (5): concentration of some heavy metals in Abou Elmonaga canal, Shubra El-khaima city, collected in June, 1998

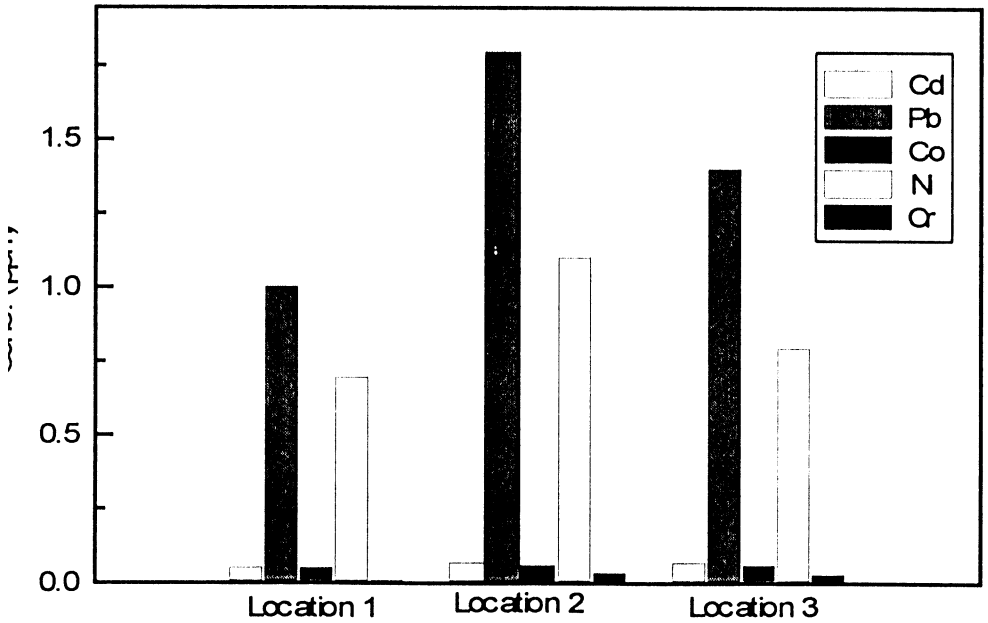

Fig. (6): concentration of some heavy metals in Abou Elmonaga canal, Shubra El-khaima city, collected in September, 1998

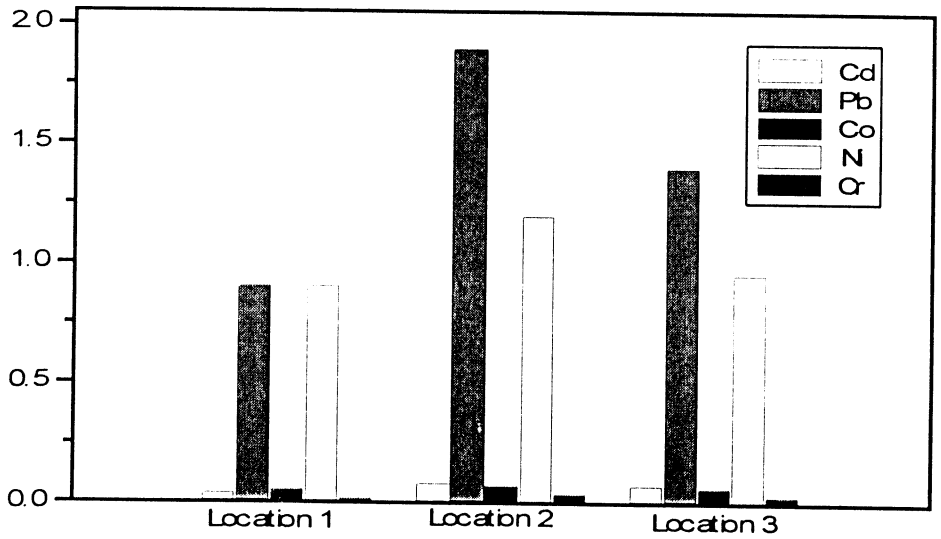

Fig. (7): concentration of some heavy metals in Abou Elmonaga canal, Shubra El-khaima city, collected in December, 1998

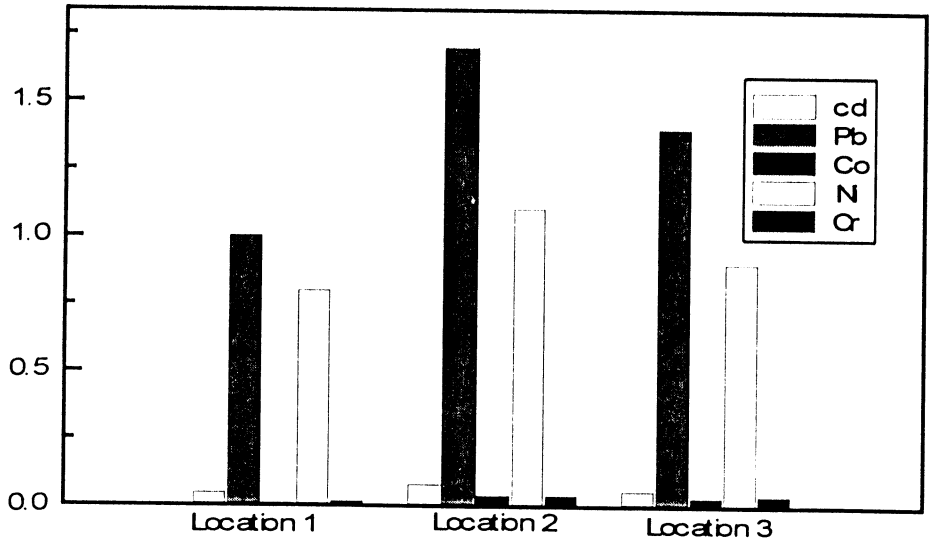

Fig. (8): concentration of some heavy metals in Abou Elmonaga canal, Shubra El-khaima city, collected in March, 1999