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Original Research Article

The Effect of Cement Dust Pollution on the *Zygophyllum Coccinum* Plant

M.A.Darweesh[1*] and M.K.El-Sayed[2]

[1]Physics and Mathematical Engineering Department, Faculty of Engineering, Tanta University, Tanta, Egypt
[2]EL-Nile for Science and Technology, Higher Institute of Engineering and Technology (HIET), Kafer El Shakh, Egypt
Corresponding author

Keywords

Zygophyllum Coccinum; height, productivity; and chlorophyll content of the plant.

A B S T R A C T

This study threw some light on the Environmental pollution resulting from cement Factory on the *Zygophyllum Coccinum* Plant. Samples of plant are collected from different places in a near by areas of a cement Factory . Due to the cement dust accumulation on exposed parts of the plant ,there were decrease in height, productivity, and chlorophyll content of the plant. The concentration of heavy metals present in the plant have been measured , and comparison was made between the concentrations of the metals in the different samples and explanation was made for these results . the results obtained agree with those present in the literature for another cement plant present in India$_{(8,7)}$ .Some Recommendations wereput to avoid the bad influence resulting from the contamination with cement dust for the workers and the employers and for the schools and the houses built in the nearest city to the cement factory under study .

Introduction

No studies have been made on the environmental pollution caused by Tabuk Cement factory. Many studies have been made on the effect of cement dust on humans or on plants at different countries. Several studies have demonstrated linkage between cement dust exposure , chronic impairment of lung function and respiratory symptoms in human population . the cement dust irritates the skin, the mucous membrane of the eyes and the respiratory system. Its deposition in the respiratory tract causes a basic reaction .leading to increased in the pH values that irritates the exposed mucous membranes (Zeleke *et al*. 2010).

Occupational cement dust exposure has been associated with an increased risk of liver abnormalities, pulmonary disorders, and carcinogenesis. Decreased antioxidant capacity and increased plasma lipid per-oxidation have been posed as possible causal mechanisms of disease (Aydin *et al* 2010).

Total cement dust exposure has been found to be related to acute respiratory symptoms and acute ventilatory effects. Implementing measures to control dust and providing adequate personal respiratory protective equipment for the production workers are highly recommended (Zeleke *et al*., 2010).

The particulate matters of the dust exhausted from the Cement plants in Mandiakudar are released to the air and it creates considerable environmental pollution. In order to monitor the ambient air quality of Mandiakudar based on suspended particulate, sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) a fact-finding survey was conducted for a period of three years from 2001 to 2003. The amount of different pollutants are compared with the standard limits recommended by Central Pollution Control Board (CPCB) and air quality parameters and/or air quality indices (AQI) are also worked out on that basis. It is also found that the people of this area badly affected by respiratory problems, gastrointestinal diseases etc .(Adak *et al* 2007). Environment is a major issue which confronts industry and business in today's world on daily basis. Different industrial activities are degrading various environmental components like water, air, soil and plant vegetation. Cement industry is one of the 17 most polluting industries listed by the Central Pollution Control Board (CPCB).The Jaypee Rewa Cement industry, Rewa, Madhaya Pradesh is located between 24°33'North longitude and 81^{o} 10' east latitudeand is situated at JayPrakash Nagar 20 km from Rewa Town of Madhya Pradesh, India. The Jaypee Rewa Cement industry is the major source of Particulate matters, SO_x, NO_x, and CO_2 emissions.

Cement dust contains heavy metals like metals like nickel,cobalt , lead, chromium, pollutants hazardous to the biotic environment with impact for vegetation, human andanimal health. Present paper attempts to focus on impact of cement emission on plant vegetation. (Kumar, 2008).

Serum, specimens from 78 workers exposed to cement dust wereanalyzed for the level of total protein and compared with the levels of albumin and globulin. In addition the calcium levels were also monitored. The total exposed population were categorized into 2groups based on the duration of exposure (duration of service in cement factory). There was a significant increase in total protein and calcium levels in the exposed subjects when compared to the controlsThe data also revealed that the maximum changes in serum proteinsand calcium occurred within an exposure time limit of total eight yearsFurther exposure to seventeen years did not reveal any additional significant changes than exposed for eight years. (Fatima,S.K.1997). The impact of cement dust deposition on mineral and energyconcentration of leaves of guava vicinity of **.**Psidiumguayava growing in the Churk Cement Factory situated at Churk, India) was studied. **)**District-Mirzapur Concentrations of calcium (Ca), potassium (K) sodium (Na) and phosphorus (P) were increased while energy content leaves than in dust-free leaves of *Psidium guayava*. Statistically it was found that the difference in the concentration of Ca, K, and P in dustyand dust-free leaves was highly correlated and significant with the amount of cement dust deposited (gm-2 leaf surface) on the leafsurface of P. guayava while the **--**difference in the concentration of Na although positively correlated--is not significant. Maximum values of

concentrations of Ca, K, Na, P and energy were 5·20%, 0·48% and 4936·7 cal g-1 dry **%**1500**0 ,%** % weight in dust-covered leavesand 3·50%, 0·30%, 0·018%, 0·12% and 5301·4 cal g-1 dry weight indust-free leaves, respectively.(Lal, B. 1982). The cement factory chosen forstudy is 'Malabar Cement Factory', it is located at Walayar, the foothills of Western ghats, Kerala. The cement kiln exhaust of the cementfactory day on **2**deposits at the rate of 2.43 g/m the vegetation around the factory and the dust contains large amount of particulate andgaseous pollutants, which can cause some physiological andbiochemical changes in the leaves of the plants. The continuousdeposition of cement dust on the surface of the leaves of the plantsreduces the chlorophyll content of the leaves and also acts as a barrierfor the photosynthesis process to take place. The deposition alsoshows a subsequent reduction of starch, carbohydrates, proteins andaminoacids in those leaves when compared to that of with normalleaves. Since the physiological and biochemical characteristics areaffected, the plant productivity gets badly affected. (Murugesan,2004)

Materials and Methods

Samples of a plant are collected from different places in a near by areas of Tabuk cement Factory. Samples (a) were taken from a place very close to the cement factory ,samples (b) were 20 Km far from the factory and samples (c) were 40 Km far away from the factory.

The samples of the plant examined from the view of its height, its productivity and chlorophyll content of the plant when exposed to the cement dust in different places.

Three samples were taken from each place the weights of the samples were as follows:

All the samples are dried in oven at 70 ^{o}C for four hours and then subjected to digestion process. This method provides for the acid digestion of the Leaves sample in a closed vessel device using temperature control microwave heating for the metal determination by spectroscopic methods.

Microwave equipment was used (Milestone ETHOS lab station with easy WAVE or easy CONTROL software HPR1000/10S high pressure segmented rotor).

The amount of Sample used was 0.5 gm and

ReagentS used were 7 ml of HNO3 65%, 2 ml of H2O2 30%

Procedure of the digestion process

1. Place a TFM vessel on the balance plate, tare it and weigh of the sample.

2. Introduce the TFM vessel into the HTC safety shield.

3. Add the acids; if part of the sample stays on the inner wall of the TFM vessel, wet it by adding acids drop by drop, then gentlyswirl the solution to homogenize the sample with the acids.

4. Close the vessel and introduce it into the rotor segment, then tighten by using the torque wrench.

5. Insert the segment into the microwave cavity and connect the temperature sensor.

Weights of the samples

:

Weight	Sample
0.5233	A1
0.5108	A2
0.4995	A3
0.5196	B1
0.5701	B2
0.5581	B3
0.5150	C1
0.5257	C2
0.4941	C3

6. Run the microwave program to completion.

7. Cool the rotor by air or by water until the solution reaches room temperature.

8. Open the vessel and transfer the solution to a marked flask.

The solution of each sample has been analyzed by Optical emission spectrometer(Perkin Elmer , Optima 7000 DV model) to determine the amount of heavy metals like Cadmium, Chromium, Copper, Iron , Mercury and Lead in the different samples.

Results and Discussion

The examination of the plant from the view of its height, its productivity and its chlorophyll content show that there were decrease in height, productivity, and chlorophyll content of the plant. because The dust from the cement factory is deposited on the vegetation around the factory this dust contains large amount of the particulate and gaseous pollutants which cause some physiological and biochemical changes in the leaves of the plants. The continuous deposition of cement dust on the leaves of the plants reduces the chlorophyll content of the leaves and also acts as a barrier for the photosynthesis process to take place when compared to that of that with normal leaves. The plant productivity gets badly affected since the physiological and biochemical characteristics are affected. Also it was observed in the polluted plants (which was very close to the factory) there were a large number of the damaged leaves . Cement dust accumulation on plant surface showed decrease in the number and size of leaves which finally affected the yield to a great extent in the dusted plants. The amount of heavy metals like (Cadmium, Chromium, Copper, Iron , Mercury and Lead) present in the samples were determined by the Optical

emission spectrometer (Perkin Elme, Optima 7000 DV model) in the different samples. These values put in tables from Table (1) to Table (9). Table (1) put in the results as an example and the others put in index. The mean values of the concentrations of the heavy metals which determined from the different samples collected in Table (2) The (10 ppm) sample was calibrated sample and (a1 , a2 , and a3) samples were taken from a place very close to the cement factory , samples (b1 ,b2 , and b3) were taken from a place 20Km far from it and samples (c1 , c2 , and c3) were from a place 40 km far from the cement factory Each sample (a1 , a2 ,……..etc) were examined four times by the optical emission spectrometer instrument and then the mean were calculated for each element of the heavy metals in the same sample. As shown from figure (1) the concentration of lead in samples (a) had a low value and increases gradually from samples (a) to sample (b) to sample (c) i.e. the concentration of lead increases when the distance between the cement factory and the plant increase . also the concentration of copper increase from ato b to c when its distance increase away from the cement factory . The low values of the concentrations of lead and copper in sample (a) is due to the continuous deposition of cement dust on the leaves of the plants which acts as a barrier for the photosynthesis process to take place While at sample (b) the plant far from the factory by 20Km so the deposition of the cement dust on the leaves of the plant decreases so the photosynthesis process takes place in a high rate and the concentrations of Pb and Cu increase , and also at samples (c) which far from the cement factory by 40km the rate of deposition decreases and the concentration increases due to its increase in the photosynthesis process .

In case of figure (2) and figure (3) the concentration of cadmium , Chromium and Iron in samples (a) had a low values and their values increases at samples (b) but at samples (c) their concentrations decreases and this results in opposite with the expected result . the low concentrations of Fe , Cd and Cr due to the pollution from the cement factory which lead to continuous deposition of the cement dust on the leaves of the plants which acts as a barrier for the photosynthesis process to take place and at samples (b) the rate of photosynthesis process increases so, the rate of deposition of the cement dust deposited on the surface of the leaves decrease because the distance from the cement factory to the place that the samples (b) were taken increase, but the concentrations of samples (c) decrease and this results in opposite with the expected result . It was expected that the concentration increase also due to the increase in the distance between the factory and the place of the plant but the analysis prove that the concentration of Cd, Cr and Fe decrease for samples (c) which its place was 40Km from the Cement Factory , this result may attributed to another source of contamination in this place which decrease the photosynthesis process which lead to decrease in their concentrations. But in case of mercury the concentration of it in the three sample a , b and c are equal zero.

The results in figure (4) show the effect of concentration of heavy metals (Cd , Cr , Fe , Pb ,Cu , Hg) increase in samples (b) more than that in samples (a) but decrease in samples (c) more than the others . This results due to samples (a) which were taken from the place near to the cement factory suffers from continuous deposition of cement dust so the photosynthesis process decreases and the concentration of

Table.1 The analysis of sample (a_1)

Sample ID:a1	Wave length	Conc. (Calib)	Conc. (Sample)	Net Intensity	Corr. Intensity
Cd	228.802	0.001 mg/l	0.001 mg/l	337.1	835.0
		0.001 mg/l	0.001 mg/l	65.9	563.8
		0.001 mg/l	0.001 mg/l	261.5	759.4
Mean :		0.001 mg/l	0.001 mg/l	191.6	689.5
SD :		0.001 mg/l	0.001 mg/l		711.9
% RSD :		0.0002mg/l	0.0002mg/l		
		18.90			
Fe	259.939	1.416 mg/l	1.416 mg/l	1584461.3	1582288.5
		1.420 mg/l	1.420 mg/l	1588090.3	1585917.6
		1.407 mg/l	1.407 mg/l	1576969.5	1574796.7
		1.415 mg/l	1.415 mg/l	1583938.5	1581765.8
Mean :		1.414 mg/l	1.414 mg/l		1581192.1
SD :		0.0053mg/l	0.0053mg/l		
% RSD :		0.37			
Pb	220.353	0.050 mg/l	0.050 mg/l	5275.7	2761.6
		0.044 mg/l	0.044 mg/l	5113.0	2598.9
		0.046 mg/l	0.046 mg/l	5175.7	2661.6
		0.045 mg/l	0.045 mg/l	5.139.5	2625.4
Mean :		0.046 mg/l	0.046 mg/l		2661.9
SD :		0.0023mg/l	0.0023mg/l		
% RSD :		5.02			
Cu	327.393	0.040 mg/l	0.040 mg/l	54945.3	51932.9
		0.04 mg/l	0.04 mg/l	54917.3	51905.0
		0.041 mg/l	0.041 mg/l	55913.7	52901.3
		0.039 mg/l	0.039 mg/l	54534.1	51521.8
Mean :		0.040 mg/l	0.040 mg/l		52065.2
SD :		0.0007mg/l	0.0007mg/l		
% RSD :		1.82			
Cr	267.716	0.001 mg/l	0.001 mg/l	7353.1	5266.6
		0.001 mg/l	0.001 mg/l	7167.9	5081.4
		0.001 mg/l	0.001 mg/l	6989.5	4903.0
Mean :		0.001 mg/l	0.001 mg/l	7138.2	5051.7
SD :		0.001 mg/l	0.001 mg/l		5075.7
% RSD :		0.0003mg/l	0.0003mg/l		
		29.24			
Hg	253.652	0.000mg/l	0.000mg/l	485.3	476.1
		0.000mg/l	0.000mg/l	617.5	344.0
		0.000mg/l	0.000mg/l	640.6	320.8
		0.000mg/l	0.000mg/l	720.4	241.0
Mean :		0.000mg/l	0.000mg/l		345.5
SD :		0.0000mg/l	0.0000mg/l		
% RSD :		0.0			

Table.2 Show the mean values of the concentration of the heavy metals of different samples.

Sample	Type of metals	Wave length	Mean (mg/l) In solution	Mean in mg in 50 ml ofsample	Mean In mg/l In the plant
10ppm	Cd	228.802	10.49	0.5245	104.9
	Cr	267.716	10.43	0.52215	104.3
	Cu	327.393	10.61	0.5305	106.1
	Fe	259.939	10.04	0.5020	100.4
	Hg	253.652	0.00	0.00	0.00
	Pb	220.353	10.17	0.5085	101.7
a_1	Cd	228.802	0.001	5×10-5	0.01
	Cr	267.716	0.001	5×10-5	0.01
	Cu	327.393	0.040	0.02	4.0
	Fe	259.939	1.414	0.0707	14.14
	Hg	253.652	0.00	0.0	0.0
	Pb	220.353	0.046	2.3×10-3	0.46
a_2	Cd	228.802	0.001	5×10-5	0.01
	Cr	267.716	0.001	5×10-5	0.01
	Cu	327.393	0.029	1.45×10-3	0.29
	Fe	259.939	1.427	0.07135	14.27
	Hg	253.652	0.00	0.0	0.0
	Pb	220.353	0.041	2.05×10-3	0.41
a_3	Cd	228.802	0.001	5×10-3	0.01
	Cr	267.716	0.003	1.5×10-4	0.03
	Cu	327.393	0.031	1.55×10-3	0.31
	Fe	259.939	1.702	0.0851	17.02
	Hg	253.652	0.00	0.0	0.0
	Pb	220.353	0.039	1.95×10-3	0.39
b_1	Cd	228.802	0.00	0.0	0.0
	Cr	267.716	0.023	1.15×10-3	0.23
	Cu	327.393	0.096	4.8×10-3	0.96
	Fe	259.939	12.81	0.6405	128.1
	Hg	253.652	0.00	0.0	0.0
b_2	Cd	228.802	0.000	0.0	0.0
	Cr	267.716	0.021	1.05×10-3	0.21
	Cu	327.393	0.089	4.45×10-3	0.89
	Fe	259.939	11.84	0.592	118.4
	Hg	253.652	0.00	0.0	0.0
	Pb	220.353	0.047	2.35×10-3	0.47

b_3	Cd	228.802	0.009	4.5×10-4	0.09
	Cr	267.716	0.027	1.35×10-3	0.27
	Cu	327.393	0.095	4.75×10-3	0.95
	Fe	259.939	14.00	0.7	140.0
	Hg	253.652	0.00	0.0	0.0
	Pb	220.353	0.059	2.95×10-3	0.59
c_1	Cd	228.802	0.00	0.0	0.0
	Cr	267.716	0.005	2.5×10-4	0.05
	Cu	327.393	0.366	0.0183	3.66
	Fe	259.939	4.588	0.2294	455.88
	Hg	253.652	0.00	0.0	0.0
	Pb	220.353	0.038	1.9×10-3	0.38
c_2	Cd	228.802	0.004	2.0×10-4	0.04
	Cr	267.716	0.005	2.5×10-4	0.05
	Cu	327.393	0.362	0.0181	3.62
	Fe	259.939	4.485	0.22425	448.5
	Hg	253.652	0.00	0.0	0.0
	Pb	220.353	0.086	4.3×10-3	0.86
c_3	Cd	228.802	0.00	0.0	0.0
	Cr	267.716	0.005	2.5×10-4	0.05
	Cu	327.393	0.360	0.018	3.6
	Fe	259.939	4.718	0.2359	47.18
	Hg	253.652	0.00	0.0	0.0
	Pb	220.353	0.190	9.5×10-3	1.9

Table.3 The mean values of the different heavy metals at different samples

Heavy metal	**a_{mean} in mg/L**	**b_{mean} in mg/L**	**c_{mean} in mg/L**
Cd	0.01	0.03	0.0133
Cr	0.017	0.237	0.05
Pb	0.42	0.98	1.05
Cu	0.33	0.93	3.63
Fe	15.14	128.8	45.97
Hg	0.0	0.0	0.0

Figure.1 Show the effect of the concentration of heavy metals (lead and copper) in the plant according to their distance from the cement factory .

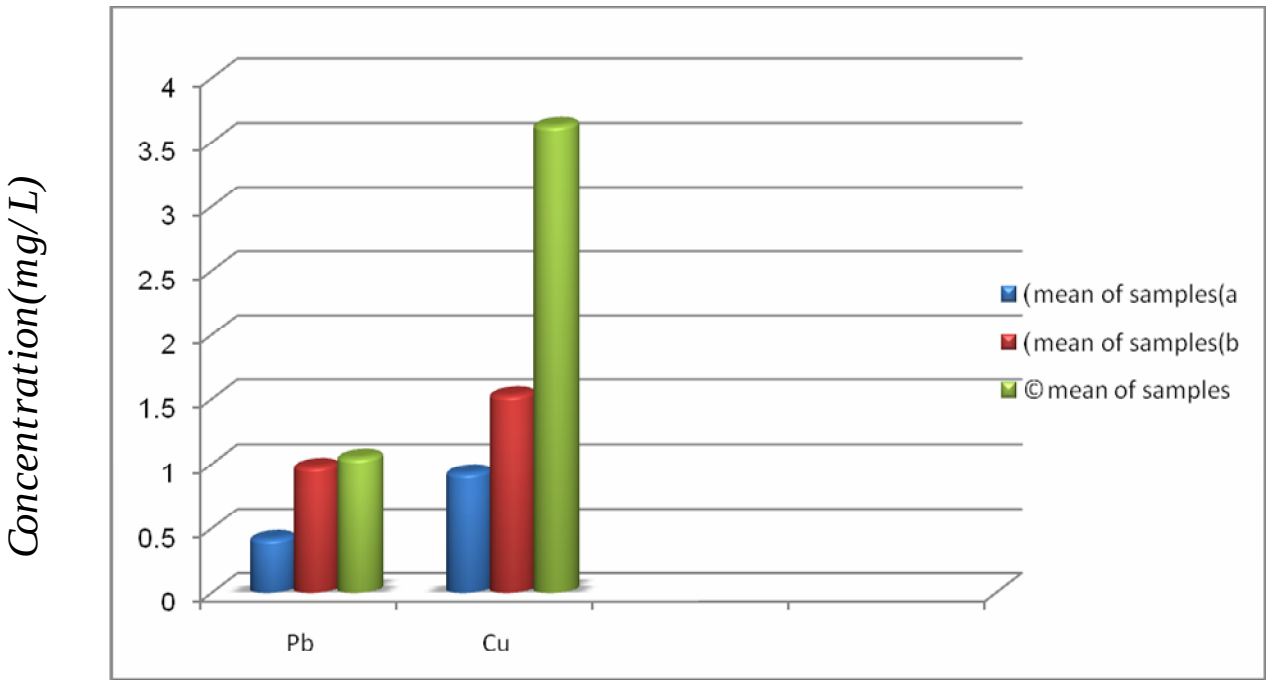


Figure.2: Show the effect of the concentration of heavy metals (cadmium and chromium) in the plant according to their distance from the cement factory .

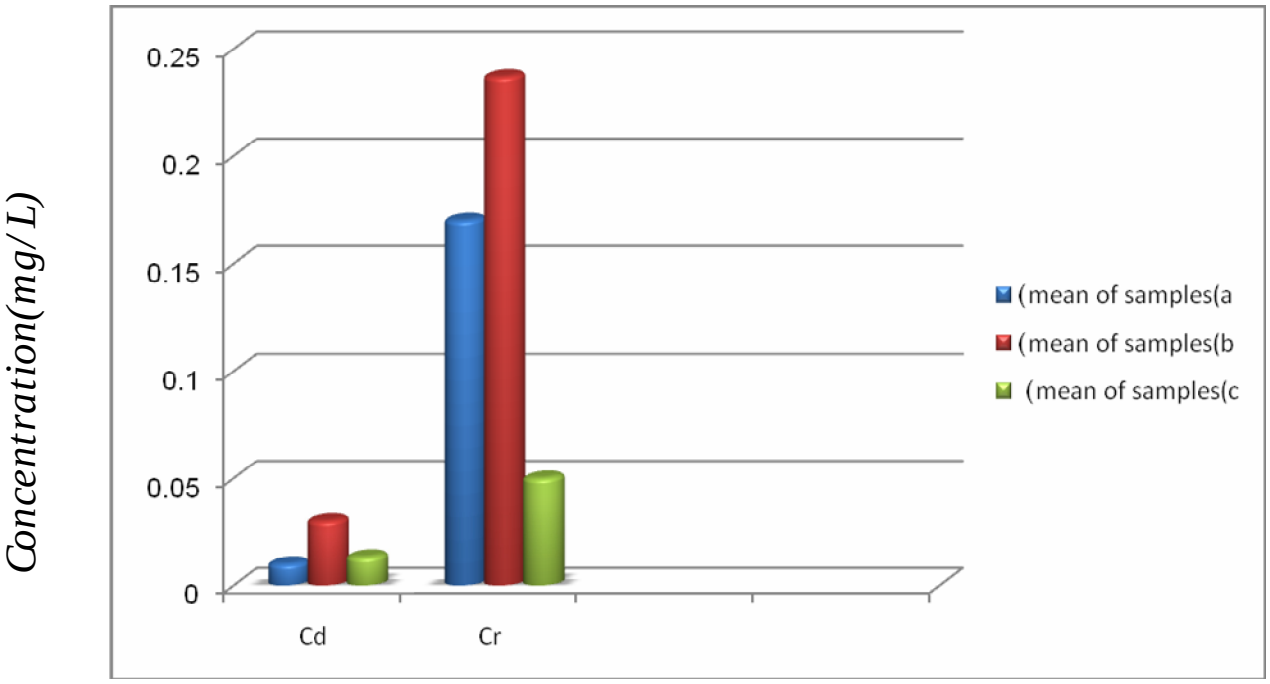


Figure.3 Show the effect of the concentration of heavy metals (Iron and mercury) in the plant according to their distance from the cement factory .

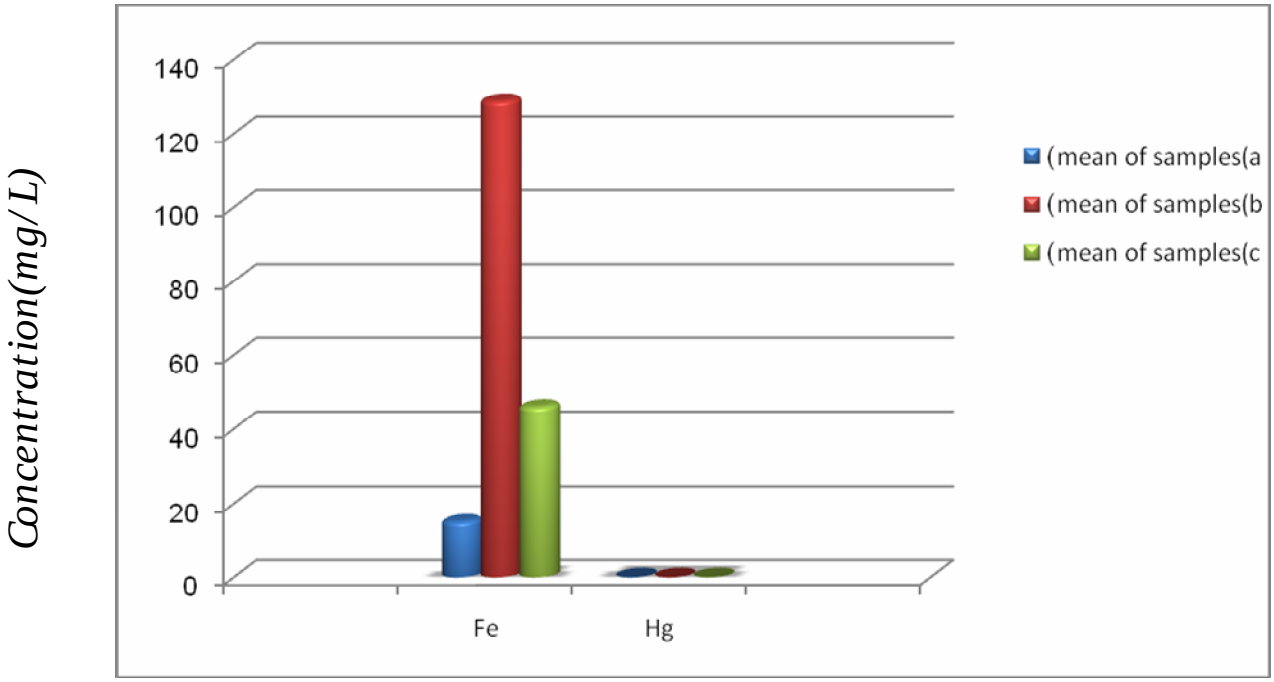
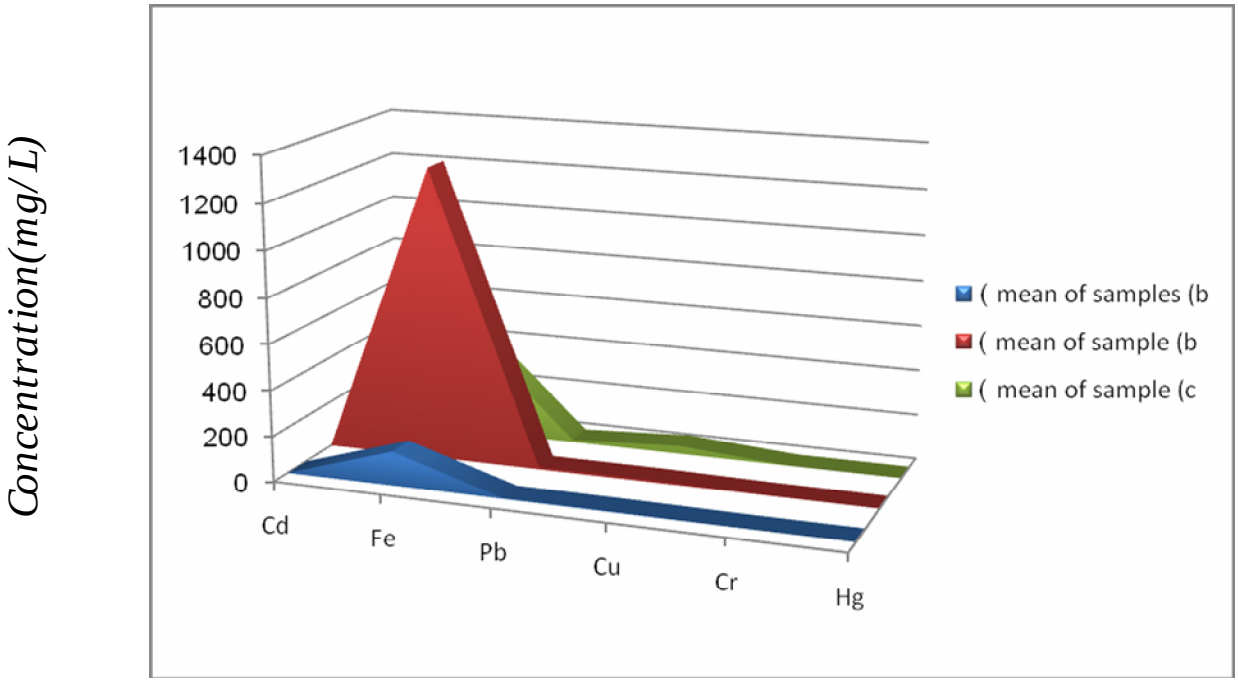


Figure.4 The effect of the concentration of heavy metals (cd , Fe , Pb , Cu , Cr , Hg) in the plant according to their distance from the cement factory



(Cd, Cu, Cr, Pb , Fe) decrease., In samples (b) the distance from the cement factory to the place where the plant increase so the rate of deposition of the cement dust in the surface of the plant leaves decrease and as a result of that the concentration of (Cd, Cu, Cr, Pb, Fe) increase, and in samples (C) it was expected that the concentrations increase but actually decreased than the concentrations in samples (b) and this is attributed to there is another source of pollution in this place. From these results Theconclosion was there were a cement dust resulting from Helwan Cement factory affected on the productivity of the Zygophyllum coccinumplant ,its height and on the chlorophyll content.These results agree with the results of Murugsan M.(8) and Lal B.(7) who obtained th same results in their studies.

Recommendations

This study proved that there are a pollution resulting from Helwancement factory and this pollution affected on the plant around the factory so, this pollution will affect also on the health of humans specially the workers and the employers on the factory specially after some years i.e. on the long runSo most of the workers and the employers who work in This cement factory exposed to the cement dust and most of Building around it suffer from the dust of cement resulting from that factory . So, Houses and Schools should keep in mind the prevailing wind direction in the region. Some recommendations were put to overcome this problem :

School buildings and rooms are required to be equipped with efficient and perpetually functioning dust capture devices.

They are also required to be isolated from the industrial production plants with robust green –belts ,plantation strips and shelterbelts.

Creating green plants takes time. So some innovations in planting technology can generate instant green cover within time span of six to twelve months.

The idea is to use 2.5 to 3 meters tall saplings for planting. In addition, stake planting for some species that are able to generate from stem cuttings can provide quick results.

Special masks must be wear by the workers and the employers have been worked in the cement plant to decrease the effect of dust resulting from the cement production on their health.

Don't use the plants present very close to the cement factory

As a natural medicine for humansand forfeeding of animals because those plants are contaminated with large amount of particulate and gaseous pollutants of cement **.**

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