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Heavy Metals Distribution and the Variation of Soil Properties around Alqaim Cement Factory in Anbar Governorate - Iraq

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Abstract: ***Soil samples collected in June 2012 (24 samples random for (0 – 30 cm) depth). It is worth mentioned that the sampling were undertaken in the direction of the prevailing wind direction away from the vicinity of cement fabric. Soil samples were air dried and sieved through 2mm analyzed for their some chemical and physical properties as well as their total heavy metals content. The results indicated that the soils of the studied area are calcareous in nature having (23% - 37.6%) sandy clay loam to sandy loam in $CaCo_2$ texture and moderately to slightly alkaline with mean (PH 8.7) especially in the surface soil samples taken near the cement factory. The soils were heavily contaminated with Cd and Co and Ni for the level of (WHO) while it was non polluted with other heavy metals. The most contaminated sites area found withen the (0 to 3km) of the cement factory.***

Keywords : Heavy metals distribution, Soil properties, Cement factory, Alqaim (Anbar)

I. INTRODUCTION

Air pollution has become a serious problem in recent time due to rapid growth of thermal power stations, cement factories, steel and coal industries in comparison to gaseous pollutants , relatively little is known about the effects of particulate pollutants, on vegetation, soil microbial population and other soil properties [5,6,11,15] the impact of the cement dust on soil properties and plant production has been investigated by some researchers [12], the determination of soil chemical and physical properties and heavy metals component are very important parameters in monitoring environmental pollution. In this respect. Ibanga et al [14] reported that moderately to high exchangeable Ca contents (3.02 – 7.44 Cmoll (t).kg^{-1}) in the soils around the cement factory in Nigeria. Also Asadu and Agada [9] studied the effect of cement dust after a period of 25 years of cement production on soil physiochemical properties. This study showed that exchangeable Ca, Na, H, Mg as well as soil organic matter were significantly higher in the affected soils than in the non-affected soils. In Tunis, Morghom et al.[8] reported an increase of Ca, K and Fe, on the surface of surrounding soils of cement factory and they suggest that the values of Si, K and Ca could be used as an indication of environment pollution in the vicinity of the cement factory, Zerronqi et al.

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[16] reported that on their study on soil surrounding cement factory on morocco that calcium oxide and sulfur oxide are the principle component of pollution. While Al-Kashman and Shawabkeh [1] revealed that lead, Zinc and Cadmium have the highest level in area close to cement factory in southern Jordan. To study area comprises the vicinity of cement factory in Al-Has an Oasis, Saudi Arabia. Al-Omron and El-Mahraby [11] indicated that the soils of area calcareous in nature, and according to go accumulation index , the soil could be classified as moderately to heavy contaminated with (As, Cd, pb and Ni) and heavily contaminated with Cr while the soils where moderately po;;uted with Zn. Xiaoya et al. [14] analyzed the heavy metal concentration of (Cu, Zu, pb, Cd, Ni, and Mu) in the surface soils industrial area in NE. China , the data reveals a remarkable change in the content of these heavy metals. Both the correlation analysis and geostatistical analysis showed that Cu, Zu, pb and Cd have a very similar spatial pattern and come from the industrial activities , while Mn mainly caused by natural factors, with recommendation need to make great efforts to control the industrial emission.

II. MATERIALS AND METHODS

Soil samples collection and analysis in June 2012 where 24 samples random for (0 – 30) cm depth were collected using a stainless steel shovel . Soil samples were stored in plastic bags , so they were air dried and gently crossed and sieved through a 2 mm sieve and stored in closed plastic containers . For chemical and physical analysis , Calcium Carbonate was determined according to [13] soil PH and Ec values were determined in soil past extract using a PH-meter and Ec -meter particul size distribution were analyzed was measured according to the method described by [13]. Soil samples were digested with a mixture 5:2:3 of MNO_3 : $HCLO_4$ HF . the digested solutions were analyzed for total (15) concentrations of Cu, Zu, pb, Cd, As, Cr, Ni, and Mu by the atomic emission spectroscopy method in [13].

III. STATISTICAL ANALYSIS

Statistical methods were applied to process the analytical data in terms of its distribution and correlation among the studied parameters. The commercial statistics software package SPSS version 17.0 was used for statistical analysis in the present study. Basic statistical parameters such as mean, median standard deviation (SD) Coefficient of variation (Cv). To indentily the relationship among heavy metals in soil and soil parameters person's correlation coefficient analysis where performed.

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IV. RESULTS AND DISCUSSION

Physiochemical properties of the soil :

The basic physiochemical properties of the collected soil samples are statistically summarized in Table (1). The texture class of soil was generally ranged from sandy clay loam to sandy loam in the most cases. In the depth (0 - 30 cm) in the maximum percentages of sand, silt and clay were (72.1, 36.8, 33.1)% while the respective minimum percentages reached (30.1, 19.8, 17.8)% respectively.

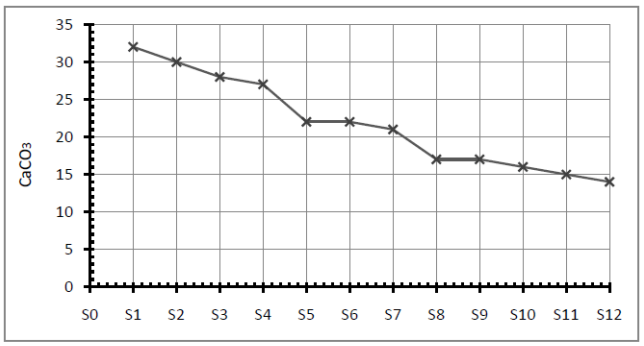
The studying soils were calcareous in nature as $CaCO_4$ content in such soils average at 24.6 % on the other hand, the PH values ranged from 7.3 to 7.6 while the Ece values ranged from 4.3 to 15.1 $ds.m^{-1}$, thus means that the studying soils were saline to alkaline affected soils. Total Ca and CaO % ranged from (9.8 to 22.8) % and (9.8 to 32.1)% respectively.

Table (1) : Statistical summary for major physical and chemical properties of the study area.

Parameter	(0 – 30) cm depth			
	Max	Min	Average	S.D.
Sand %	72.1	30.1	60.3	11.1
Silt %	36.8	19.8	23.2	7.2
Clay %	33.1	17.8	16.5	5.2
PH	7.6	7.3	7.4	1.2
Ec ($ds.m^{-1}$)	15.1	4.3	7.8	1.8
$CaCO_3$ %	32.0	20.8	24.6	4.1
Total Ca%	22.8	9.8	18.6	4.3
Total CaO %	32.1	9.8	15.2	6.1

Table (2) : Total heavy metals contents ($mg.k^{-1}$) in the soil (0 - 30 cm depth) the Alqaim cement factory west of Iraq. Compared to common ranges in soil.

Metal	Total heavy metals contents in the soil (0 – 30 cm depth)									
	Cr	Pb	Cd	Zn	Cu	Ni	CO	Mn
S1	36.3	4.5	0.3	6.8	3.2	1.3	7	50
S2	36.2	4.5	0.2	6.5	3	1.3	7.5	55
S3	36	4.3	0.2	6.8	3	1.2	8	56
S4	36	4.4	0.5	7.3	3.2	1.0	8.2	56
S5	35.8	4.3	0.5	7.5	3.4	1.0	8.2	50
S6	35.8	4.3	0.4	7.8	3.4	1.1	8	50
S7	35	4.3	0.4	7.8	3	1.2	8	53
S8	35	4.5	0.3	7.9	2.8	1.1	8.1	53
S9	35.3	4.5	0.3	7.9	2.8	1.2	8.1	50
S10	35.3	4.8	0.2	8	2.7	1.1	8	50
S11	35	4.8	0.2	8.1	2.7	1.2	8	50
S12	35.3	4.8	0.3	8.1	2.6	1.3	8	50
S13	41.6	18.3	3.8	31	12.5	10	23.6	290
S14	40	18.5	3.8	32	12.5	10.5	23.5	300
S15	40	58.5	3.7	48	13	10.5	26	300
S16	40.5	66	3.9	48.5	15	11.1	26.4	310
S17	39	59	3	50	16.5	11.2	26.5	310
S18	39.5	60	3	50.9	16.7	11	30	290
S19	39.3	60.5	3.4	53	16.8	10.5	30.3	290
S20	39	15.5	3.4	54	18	10.8	30.4	280
S21	38.5	16.6	2.8	53	17.3	10.8	23.8	280
S22	38.6	16.8	2.8	60	17.5	10	23.5	270
S23	38	16.5	2.7	61	19	10.3	23.5	270
S24	38	16.5	2.6	63	19.7	10.2	24	260
Avg.	37.45	19.8	1.7	28.9	9.6	5.9	16.9	169.7
Common Range in soil $Mg.kg^{-1}$	100	60	0.6	150	35	40	0.7	300



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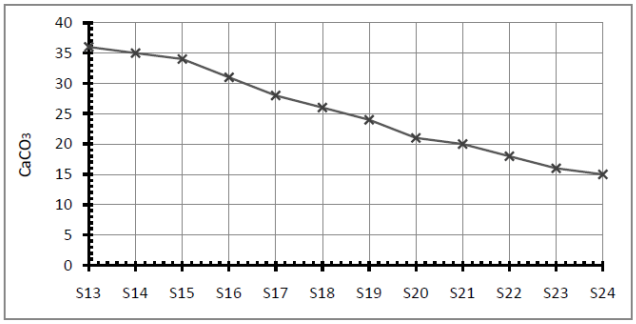
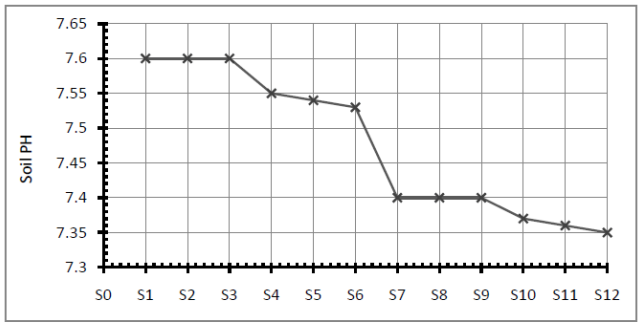


(B)

Figure (1) : Distribution of ($CaCO_3$ %) in the soil (0 – 30) cm depth with the random samples of the cement factory.



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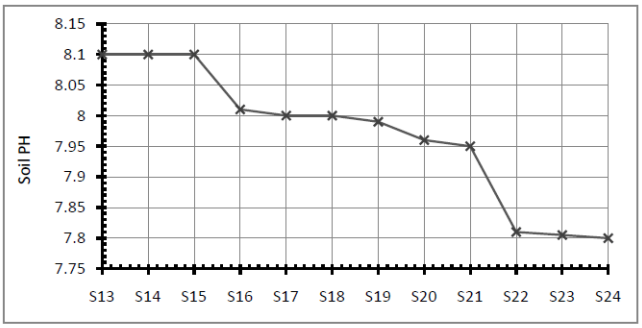

(b)

Figure (3) : Distribution of PH in the soil (0 – 30) cm depth with the random samples of the cement factory.

V. HEAVY METALS CONTENT IN THE SOIL

They in table (2) shows average concentrations of heavy metals of soil sample along the studied transect compared to the average concentration and normal ranges in soil reported by Lindsay (1979). The mean value of the metals content in the studied soil depth could be arranged in the following descending order.

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Mn > Zn > Cr > Pb > CO > Cu > Ni > Cd obviously , the levels of Cd and CO were higher, where as the values of the other metals were lowest observed. It is worth to mention that most of the heavy metals contaminated soil samples were situated more closed to the cement factory , This finding is in agreement with the results reported by Al-Omran and El-Maghraby (2011) for the soil around cement factory in Jordan and Saudi Arabia respectively.

VI. CONCLUSION

From the a fore mentioned results it could be conducted that the soil of the studying area could be classified as moderately to heavily contaminated sites were situated in the 0 to 25 km far from the cement factory, results also suggest that the metals content in the studying soil were positively correlated with the soil PH, soil organic matter and silt and clay content, Moreover the Cd and Co were also positively correlated with Soil $CaCO_3$ content (Table 3).

Table (3) : Pearson Coefficient between some soil properties and among metals in the study area.

	Cd	Cr	Cu	Ni	Pb	Zn
Clay %	0.20	0.18	0.02	0.16	0.26	0.28
Silt %	0.15	0.32	0.16	0.28	0.08	0.07
Sand %	0.19	- 0.12	- 0.09	-0.11	0.05	0.17
O.M %	0.32	0.49	0.64	0.11	0.49	0.52
$CaCO_3$ %	0.64	0.45	- 0.15	- 0.19	- 0.08	- 0.06
PH	0.22	0.20	0.05	0.04	0.25	0.38

Table (4) : Results of testing dust precipitators of the ovens for cement Aqasim.

Chemical tests (Type of test)	**Samples of dust precipitators of the ovens %**
Silicon oxide (SiO_2)	13.4 - 14.64
Aluminum oxide (Al_2O_3)	3.5 – 4.3
Iron oxide (Fe_2O_3)	2.5 – 3.7
Calcium oxide (CaO)	38 – 40.9
Magnisume oxide (MgO)	2.9 – 3
Sulfate (SO_3)	8.6 – 10.6
Loss by burning (L.O.T)	15.5 – 19.2
Chlorides and Alkalizes ($Cl+Na_2O+K_2O$)	6 - 7

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