

Journal of Soil Sciences and Agricultural Engineering

Journal homepage & Available online at: www.jssae.journals.ekb.eg

The Specific Adsorption of Manganese and Cadmium in North East Nile Delta Soils

Ahmed, H. A.; S. M. Abou EL-Enan; T. Mosalm and A. S. Hassan*



Soils and Water Dept. Fac. of Agri. Al-Azhar Univ. Cairo. Egypt.



ABSTRACT

This study deals with the relationship between soil properties and the specific adsorption of manganese and cadmium in some soils of the north eastern Nile Delta region. This work was conducted on seven different soil profiles of heavy clay soil texture. To achieve this goal, a detailed study was conducted on the most important physical and chemical properties of the collected soil samples, then a quantitative specific adsorption experiment was carried out. The specific adsorption of manganese and cadmium ions in the presence of sodium, as a monovalent cation and calcium as a divalent cation and as shown on that the higher the added concentration, the higher the specific adsorption as shown by the straight line equation on for manganese and cadmium, while the role of Sodium as a single cation helps the adsorption of manganese and cadmium in the superficial layers rather than the sub-surface layers due to the presence of organic matter and clay content. In the presence of calcium, the specific adsorption of manganese and cadmium decreased, as calcium occupies all exchange sites on the adsorption complex as a binary cation. However in the presence of calcium The adsorption increased in the surface layers than in the sub-surface layers due to the presence of organic matter and clay content in the surface layer than the sub-surface layer.

Keywords: The specific adsorption; manganese; cadmium and clay soils

INTRODUCTION

The transition metals in the periodic table are naturally occurring in the environment, particularly in the Earth's crust. They are the 38 elements in groups 3 through 12 of the periodic table. As with all metals, the transition elements are both ductile and malleable, and conduct electricity and heat. The most important thing about transition metals is that their valence electrons, or the electrons they use to combine with other elements, are present in more than one shell. This is the reason why they often exhibit several common oxidation states.

Anthropogenic activities, primarily industrial technologies, have precipitated significant alternations in the concentration and distribution of these metals.

Certain elements are naturally occurring in the animal and human plasma and tissues, but their concentrations are sometimes too low to be detected using the some of them have even been suggested to have a beneficial role in the human or animal physiology. However, exposure to excessive anthropogenically elevated levels can exert serious negative effects on the environment, agriculture and health. They affect a wide range of processes, including anaerobic degradation of organic matter, biogeochemical cycling and availability of trace elements, and the mobility, redox transformation and toxicity of organic and inorganic contaminants.

This research is undertaken with the intention of increasing our knowledge about the specific adsorption of manganese (Mn: [Ar] 3d⁵ 4s²) and cadmium (Cd: [Kr] 4d¹⁰ 5s²). Their electronic structure lets them form compounds at various valences. The electronic structure gives them their outstanding ability to form ions containing more than one atom (complex ions, or coordination compounds), with a central atom or ion surrounded by ligands in a regular arrangement.

The contaminating products are integrated into the complex soil system and distributed amongst the different forms present, namely the solid forms, soluble and insoluble organic-mineral complexes adsorbed and exchangeable forms, and free ions in soil solution.

When a contaminating substance is present in the soil, its effect is directly related to its reactivity, rather than to its total amount or concentration.

It is very important to know that the physical and chemical properties of the soil play a great role in governing the relationship between reactivity and total content of the contaminating substance. However, its action is specifically linked to the nature of the pollutant, which may be, more or less, toxic.

The specific Adsorption of heavy metal ions:

The specifically adsorbed heavy metal cations could be defined as the amount of adsorbed heavy metals cations in presence of different amounts of some cations large enough to prevent adsorption on normal cation exchange sites as mentioned by Mc Laren and Crawford (1973).

Manganese:-

Manganese is also essential in the synthesis of chlorophyll and is similarly affected by calcium and phosphorus, (Huber, 1980). Manganese is a constituent of only one known plant component, but it activates various enzymes involved in nitrate reduction, carbohydrate metabolism, and respiration.

Cadmium:-

Adsorbed to mineral surfaces or organic materials is more easily bioaccumulated or released in a dissolved state when sediments are disturbed, such as during flooding (Berkowitz et al., 2008). Cadmium behavior is governed by several physical and chemical processes in soils. It may be retained in soils through precipitation and adsorption

* Corresponding author.

E-mail address: samy32samy32@gmail.com

DOI: 10.21608/jssae.2022.129521.1071

reactions. For instance, Cd is associated with several mineral phases during flooding periods in the paddy soils, including carbonates, kaolinite, ferrihydrite, humic acid, and Cd (Khaokaew et al., 2011).

Effect of sodium on heavy metal ion adsorption

The insertion of Na into halloysite significantly could affect the Mn adsorption. magnitude in enhancement of manganese adsorption on solid phase thus depends on the content of the carboxylic functional groups, which increases with the insertion of COO⁻ into the halloysite matrix. The involved mechanism may be quite complex. It implies electrostatic considerations and a cationic exchange process. The most were found to be very effective as adsorbent of copper from aqueous solutions Senia Mellouk et al.(2011) .

Other effects of buffer pre-treatment are an additional release of soluble organic acids and a cation exchange where H⁺ in carboxylic and hydroxyl groups is substituted by Na⁺ Depending on the increase in pH as a result of buffer treatment, the peat macromolecules will become more negatively charged. The molecules will Effect of sodium on heavy metal ion adsorption

The insertion of Na into halloysite significantly could affect the Mn adsorption. magnitude in enhancement of copper adsorption on solid phase thus depends on the content of the carboxylic functional groups, which increases with the insertion of COO⁻ into the halloysite matrix. The involved mechanism may be quite complex. It implies electrostatic considerations and a cationic exchange process. The most were found to be very effective as adsorbent of copper from aqueous solutions Senia Mellouk et al. (2011) .

Other effects of buffer pre-treatment are an additional release of soluble organic acids and a cation exchange where H⁺ in carboxylic and hydroxyl groups is substituted by Na⁺. Depending on the increase in pH as a result of buffer treatment, the peat macromolecules will become more negatively charged. The molecules will repel each other and the structures will be more uncurled, resulting in a greater number of active sites for adsorption of metals Kalmykova, et al. (2008).

On the other hand, the carbonate fraction could be extracted by mild acidic solutions. In general, the applications of sequential extraction methods were summarized by Filgueiras et al. (2002) to characterize pollution sources, evaluation of metal mobility and bioavailability, and identification of binding sites of metals for assessing metal accumulation, pollution and transport mechanisms. Although sequential extractions are time consuming, these methods provide imperative knowledge about element mobility and availability in soil. However, the measurement of total concentration of metals in soils is useful to detect any net change due to different possible phenomena. Sequential extraction procedures cannot be used as stand-alone evaluations to identify the actual form of metals in soils and should be accompanied by deeper experimental investigations (Dahlin et al.,2002).

Effect of Calcium on heavy metal ion adsorption

There is a distinct relationship, of ion and metal ion, in the presence of Ca⁺² from any salts where adsorption of many heavy metals was much reduced , suggesting that Ca⁺² compete with the metals on the exchange sites. This fact was indicated by many investigators, Cavallaro and McBride (1978) McBride (1980). Christensen (1984) and Mehta et al (1984). However, Raikhy and Takkar (1983) concluded that adsorption of zinc by soil was significantly proportional to

calcium carbonate content. They also added that removal of soil carbonate has decreased the adsorption of Zn, Cu, Mn and Cd.

Pendias and Pendias (1992) stated that major soluble ions greatly influence the quantities of soluble trace elements, so these ions play an important role in governing trace elements availability to plants .Solution of most soils contains an excess of Ca, which in many cases constitutes more than 90% of the total cation concentration. Therefore, Ca is the most important cation in governing the soluble state of trace elements in soils. They added that there are examples of soils in which complex trace cations prevent precipitation in the presence of Ca and in soil solutions having a relatively high pH level, even higher than normal concentration.

MATERIALS AND METHODS

This study aims to obtain some information regarding the importance of the specific adsorption of some heavy metals, namely manganese and cadmium, in heavy clay soils North east Nile Delta as a contribution to dealing with the problems of soil contamination with heavy metals.

The study area located in the north eastern part of the Nile Delta of Egypt, extends between latitudes 30o 20" N and 31o 10" N longitudes 31 o 50" E and 32 o 10" . It covers parts of Dakahlya and Sharkia governorates the area is bounded by EL-Manzala Lake on the north, Suez Canal in the east, Damietta Nile branch in the west and Cairo Ismailia desert road in the south.

1. Climate:

The climate in the selected areas is arid characterized by long hot rainless summer, short rainy winter, high evaporation rate and low relative humidity.

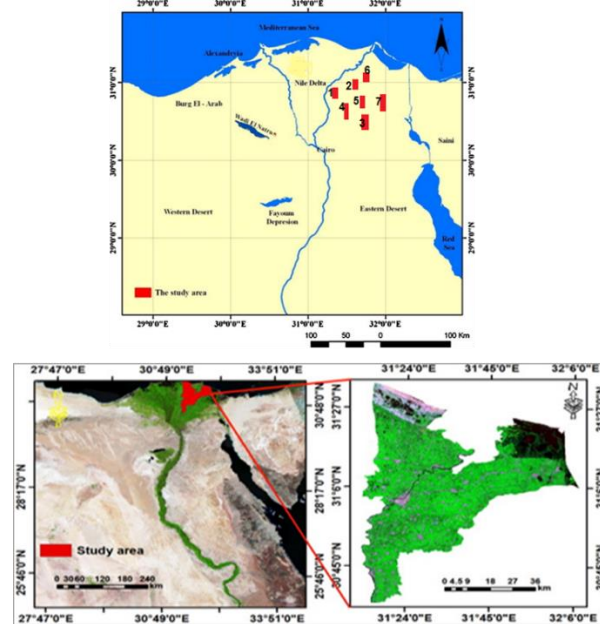


Fig. 1. Locations of the studied profiles.

2. Soil profiles:

Seven soil profiles representing the main soils in the north eastern part of the Nile Delta of Egypt were studied. They were morphologically described in the field. According to the USDA, (2012). Soils samples were finely grounded crushed to pass through 2 mm sieve and stored for analyses. Soil Physical and chemical analyses were carried out according to Soil Survey Laboratory methods (USDA,2004). Cation exchange capacity (CEC) was determined according to the method mentioned in Richards (1954). Total N was

determined by the microkjeldahl method as described by Jackson (1963). Phosphorus content was determined using spectrophotometer according to FAO Soil Bulletin (1989). Potassium content was determined photometrically using Flame photometer as described by Chapman and Pratt (1982). Exchangeable cations were determined using sodium and ammonium acetate as outlined by Bower (1959). Available N was extracted by 2M KCl and determined by the micro Kjeldahl, Mulvaney (1996) Available K and P were extracted by ammonium bicarbonate diethylene triamine pentaacetic acid (AB/DTPA), Soltanpour and Schwab (1977). The chemical composition of the studied soils was determined by X-Ray Fluorescence (XRF) (Philips, PW2400).

3. Specific adsorption experiments:

The specific adsorption experiments were carried out on the surface (a) and subsurface (b) soil samples of profiles No.1, 2, 3 and 4 as follow:

Specific adsorption in the presence of Na- dominance:

The specific adsorption of manganese and cadmium was measured by shaking 10 gm soil for 24hrs with 50ml Na-acetate (1.N) pH 8 solutions containing (0.0 ,0.004, 0.008 and 0.012) meq/l Mn (the same with Cd), McLaren and Crawford (1973).

Once in solution Mn as well as Cd was determined by (ASS) Atomic absorption spectrophotometer.

Specific adsorption in the presence of Ca- dominance:

The same as the aforementioned experiment was carried out using Ca- acetate (1.N) pH 8 solutions.

RESULTS AND DISCUSSION

The morphological characteristic of the studied soil profiles are summarized in Table 1.

The Physical and chemical properties of the studied soil profiles are in Tables 2,3,4,5 and 6. The Figures are shown in 2, 3, 4, 5 and 6. The obtained results indicate that soil profiles No1,2,3,4,5 and 7 represent Vertisols order. (Hassan 2017), Torrierts and Haplotorrierts.(according to the Soil Survey Staff 2006). Soil texture is clay The clay contents ranges from 37.7% to 46.5% and the structure varies from granular to strong angular blocky. The calcium carbonate contents ranges between. 1.3%

and 7.5%. Electrical conductivity values of the saturation extract indicate that the soil profiles are low to moderately saline. The data indicate also that the soils are almost neutral to slightly strong alkaline, pH range between 7.5 to 9.7. The organic matter content range from 0.2 to 3.6 %. electrical conductivity values of these soils vary from 1.4 to 32.7 ds/m-1. Total soluble salts are extremely high. Soluble cations and soluble anions can be arranged in the following descending order $Na^+ > Mg^{++} > Ca^{++} > K^+$ vs $SO_4^- > Cl^- > HCO_3^-$ in the different profile layers. Cation exchange capacity is high, where it ranged between 14.3 and 52.5 meq/100 g soils. Gypsum content is low ranging between 0.8% and 1.9%.

Concerning soil fertility, data of available nitrogen ranges from 10.08 to 50.4 ppm in these soils, according to Dahnke and Johnson (1990) these soils have low levels of available nitrogen. Available phosphorus ranges from 1.1 to 12.06 ppm. With respect to available potassium, it ranges from 253.7 to 868.4 ppm. According to the index value reported by Soltanpour and Schwab (1977), available phosphorus and potassium occur at low levels, and they are insufficient for plant growth.

The results showed the specific adsorption of manganese and cadmium ions in the presence of sodium. as a monovalent cation and calcium as a divalent cation and as shown on the graph (Fig. 7 , 8, 7a and 8a) that the higher the added concentration, the higher the specific adsorption as shown by the straight line equation on for manganese and cadmium, while the role of Sodium as a single cation helps the adsorption of manganese and cadmium in the superficial layers rather than the sub-surface layers due to the presence of organic matter and clay content, Senia Mellouk et al. (2011) . In the presence of calcium, the specific adsorption of manganese and cadmium decreases, as calcium occupies all exchange sites on the adsorption complex as a binary cation. However, in the presence of calcium The adsorption increased in the surface layers than in the sub-surface layers due to the presence of organic matter and clay content in the surface layer than the sub-surface layer Cavallaro and McBride (1978) McBride (1980).

Table 1. Main morphological features of soil profiles.

Soil Profiles	Depth	Color		Texture	Structure	Consistence			
		Dry	Moist			Dry	Mst	Stk	Pls
1	0-25	10YR2/3	10 YR3/3	C	GR	Vh	sh	VS	VP
	25-50	10YR3/2	10 YR3/3	C	ABK	Vh	fi	VS	VP
	50-120	10YR2/2	10YR 3/2	C	SBK	Vh	fi	VS	VP
2	0-20	10YR4/2	10YR4/3	C	GR	Vh	sh	VS	VP
	20-40	7.5YR4/1	7.5YR4/4	C	ABK	Vh	sh	VS	VP
	60-110	7.5YR4/3	7.5YR4/4	C	ABK	Vh	sh	VS	VP
3	0-30	10 YR 4/3	10 YR3/3	C	ABK	Vh	fi	VS	VP
	30-55	10 YR4/2	10 YR3/3	C	SBK	Vh	fi	VS	VP
	55-130	7.5YR4/2	10 YR3/3	C	SBK	Vh	fi	VS	VP
4	0-25	10 YR4/2	10 YR3/3	C	SBK	Vh	fi	VS	VP
	25-50	10 YR3/1	10 YR3/2	C	SBK	Vh	Sh	VS	VP
	50-110	10 YR4/3	10 YR3/3	C	ABK	Vh	Sh	VS	VP
5	0-30	7.5YR4/2	10YR2/3	C	GR	Vh	Sh	VS	VP
	30-60	7.5YR3/3	10YR3/4	C	GR	Vh	Sh	VS	VP
	60-120	10 YR3/2	10YR2/3	C	GR	Vh	Sh	VS	VP
6	0-25	10 YR4/2	10YR4/3	C	SBK	Vh	Sh	VS	VP
	25-50	10YR4/3	10YR3/3	C	GR	Vh	Sh	VS	VP
	50-100	10 YR 4/2	10 YR 4/3	C	GR	Vh	Sh	VS	VP
7	0-30	10 YR3/2	10YR2/3	C	GR	Vh	Sh	Vfi	VP
	30-55	10YR3/2	10YR2/2	C	SBK	Vh	Sh	VS	VP
	55-110	10 YR 2/2	10 YR 2/3	C	SBK	Vh	Sh	VS	VP

Table 2. Some physical characteristics of the studied soil profiles.

Soil Profiles	depth cm	Particle size distribution (%)			Texture class	Particle Density (g/cm ³)	Bulk Density (g/cm ³)
		Sand	Silt	Clay			
1	0-25	23.24	30.48	46.28	Clay	2.26	1.8
	25-50	21.28	32.4	46.32	Clay	2.27	1.9
2	50-120	23.16	30.36	46.48	Clay	2.32	1.6
	0-20	23.49	30.3	46.21	Clay	2.41	1.8
3	20-40	23.35	31.22	45.43	Clay	2.31	2
	60-110	23.46	32.03	44.51	Clay	2.28	1.6
4	0-30	21.42	32.09	46.49	Clay	2.26	1.6
	30-55	31.46	30	38.54	Clay	2.28	2
5	55-130	29.44	30.06	38.5	Clay	2.25	1.9
	0-25	29.4	29	41.6	Clay	2.29	1.6
6	25-50	30.43	30	39.57	Clay	2.21	2
	50-110	29.34	32.96	37.7	Clay	2.31	1.9
7	0-30	28.41	31.11	40.48	Clay	2.45	1.9
	30-60	28.44	30.12	41.44	Clay	2.54	1.9
8	60-120	28.48	33.46	38.06	Clay	2.88	1.5
	0-25	23.39	42.1	34.51	Clay Loam	2.78	1.8
9	25-50	31.33	40.19	28.48	Clay Loam	2.95	1.9
	50-100	32.41	36	31.59	Clay loam	2.95	2
10	0-30	29.43	28	42.57	Clay	2.45	1.9
	30-55	24.55	30	45.45	Clay	2.22	1.9
11	55-110	25	30	45	Clay	2.72	1.9

Table 3.a. Some chemical characteristics of the studied soil profiles.

Soil Profiles	depth cm	EC dSm ⁻¹	PH	Soluble cations meq/L				Soluble anions meq/L		
				Na ⁺	K ⁺	Ca ⁺⁺	Mg ⁺⁺	CL ⁻	HCO ₃ ⁻	SO ₄ ^{F-}
1	0-25	2.68	7.94	13.67	0.09	6	7	5	3	18.76
	25-50	2.84	8.03	16.82	0.1	5.5	6	5	4.5	18.92
	50-120	3.65	8.07	20.42	0.08	12	4	6.5	4	25.5
2	0-20	2.85	7.53	9.33	0.18	10	9	3.2	3.5	21.31
	20-40	1.58	8.04	7.64	0.11	6	2	3	3	9.25
	60-110	3.3	8.02	16.34	0.16	7.5	9	3	2.5	27
3	0-30	1.95	8	5.88	0.13	5.5	8	1.2	4.5	13.31
	30-55	1.4	8.43	5.95	0.07	8	0	2.5	3	8.52
	55-130	1.16	8.65	6.48	0.13	5	0	1	3.5	6.61
4	0-25	2.51	8	12.85	0.21	8	4	7.2	5.5	11.86
	25-50	2.23	8.89	13.67	0.11	8.5	0	2.5	6	13.28
	50-110	1.72	9.3	12.14	0.1	5	0	3.2	4.5	9.04
5	0-30	2.09	8.17	11.65	0.21	7.5	1.5	3.5	8.5	8.36
	30-60	1.63	8.56	9.25	0.09	7	0	2.2	4.5	9.14
	60-120	1.41	8.51	8.99	0.08	5	0	1.5	4	8.07
6	0-25	32.73	8.93	283.71	1.08	20	22.5	44.5	2.5	279.79
	25-50	0.82	9.7	2.51	0.2	5.5	0	3.5	5	0.21
	50-100	1.84	9.33	8.2	0.19	10	0	3.2	4.5	10.19
7	0-30	1.54	8.82	9.85	0.09	5.5	0	2.5	4	8.44
	30-55	1.64	8.9	9.36	0.06	7	0	2.2	3	10.72
	55-110	3.04	8.81	12.29	0.09	7.5	10.5	2.5	5	22.38

This research was conducted to study the state of manganese and cadmium with special emphasis on their adsorption by heavy clay soils, moreover, an attempt was made to assess the absorption of these elements from soil under variable concentrations (0 - .004 - .008 - .012)

Surface and subsurface soil samples were collected from four sectors within the study area.

The clay contents ranges from 37.7% to 46.5% and structure varies from granular to strong angular blocky. The calcium carbonate contents range between 1.3% and 11.5%. Electrical conductivity values of the saturation extract indicate that the soil profiles are in Table 3 moderately to low saline. The data indicate also that the soils are almost neutral to slightly alkaline, pH range between 7.5 to 9.7. The organic matter content range from 3.6 to 0.2 %. Electrical conductivity values of these soils vary from 1.4 to 32.7 ds/m⁻¹. Total soluble salts are extremely high. Soluble cations and soluble anions can be arranged in the following descending order Na⁺ > Mg⁺⁺ > Ca⁺⁺ > K⁺ vs SO₄⁻ > Cl⁻ > HCO₃⁻ in the

different profile layers. Cation exchange capacity is high, where it ranged between 14.3 and 52.5 meq/100 g soils. Gypsum content is low ranging between 0.8% and 1.9%.

Table 3.b. Some chemical characteristics of the studied soil profiles.

Soil Profiles	depth cm	Exchangeable ions meq 100g ⁻¹ Soil				ESP	% Total		
		Na	Ca	K	Mg		N	P	K
1	0-25	9.7	33.0	0.8	1.8	21.44	0.21	0.03	0.12
	25-50	12.5	36.0	0.8	1.7	24.46	0.15	0.02	0.14
	50-120	14.0	38.0	0.7	1.5	25.85	0.40	0.02	0.12
2	0-20	6.6	42.0	1.3	1.4	12.89	0.15	0.10	0.21
	20-60	7.8	38.0	1.2	1.7	16.03	0.09	0.02	0.12
	60-110	8.6	37.0	1.0	1.8	18.01	0.09	0.02	0.19
3	0-30	5.5	37.0	1.1	1.6	12.09	0.06	0.01	0.16
	30-55	8.2	41.0	1.0	1.5	15.84	0.06	0.07	0.16
	55-130	8.2	32.0	1.0	1.6	19.11	0.05	0.04	0.15
4	0-25	10.1	36.0	1.5	1.8	20.49	0.46	0.002	0.17
	25-50	12.1	30.0	1.3	1.9	26.66	0.15	0.002	0.15
	50-110	16.0	27	1.2	1.6	34.86	0.13	0.10	0.19
5	0-30	7.0	39.0	1.3	1.3	14.44	0.06	0.002	0.11
	30-60	7.4	33.0	0.8	2.0	17.03	0.05	0.04	0.13
	60-120	8.2	43.0	0.8	1.6	15.24	0.09	0.12	0.11
6	0-25	15.6	24.0	1.4	0.8	37.22	0.10	0.06	0.12
	25-50	7	25.0	1.0	0.7	20.79	0.05	0.02	0.11
	50-100	8.2	30.0	1.1	0.7	20.42	0.06	0.02	0.11
7	0-30	9.3	39.0	2.2	1.6	17.92	0.05	0.06	0.13
	30-55	9	37.0	2.0	1.5	18.12	0.05	0.04	0.13
	55-110	9	38.0	0.7	2.1	18.02	0.05	0.05	0.11

Table 4. Some chemical characteristics and available NPK of the studied soil profiles.

Soil Profiles	depth cm	Gypsum %	CEC	CaCO ₃ %	O.M %	Available (ppm)		
						N	P	K
1	0-25	1.3	43.52	4.60	2.97	17.62	5.0	0.12
	25-50	1.2	46.40	5.52	1.99	10.08	5.0	0.14
	50-120	1.1	46.40	11.5	0.93	10.08	3.9	0.12
2	0-20	0.8	40.00	7.36	3.29	38.02	6.3	0.21
	20-40	0.9	40.64	8.74	1.16	12.6	6.1	0.12
	60-110	1.6	40.32	4.60	0.64	11.34	2.6	0.19
3	0-30	1.5	39.04	6.90	1.15	20.16	6.7	0.16
	30-55	1.3	41.60	3.68	0.86	15.12	6.7	0.16
	55-130	1.2	40.96	3.22	0.72	15.12	4.6	0.15
4	0-25	1.0	56.64	11.50	0.76	50.4	4.3	0.17
	25-50	1.1	41.28	7.36	1.25	20.16	4.3	0.15
	50-110	0.9	43.84	11.50	0.82	15.12	3.3	0.19
5	0-30	1.2	41.6	4.6	3.65	70.57	8.9	0.11
	30-60	1.6	36.8	3.22	1.18	20.16	3.7	0.13
	60-120	1.4	46.72	1.84	0.82	17.64	10	0.11
6	0-25	1.3	14.72	3.22	1.5	30.24	12.6	0.12
	25-50	1.5	10.88	2.76	0.63	15.12	4.3	0.11
	50-100	0.7	22.08	1.38	0.66	15.12	1.1	0.11
7	0-30	1.9	62.08	3.68	1.04	15.12	4.8	0.13
	30-55	0.8	42.88	2.3	0.75	10.08	2.6	0.13
	55-110	0.9	49.6	3.22	0.82	10.8	7	0.11

Table 5. The percent of some total element oxides of some soil profiles.

Profil No.	depth cm	CuO	ZnO	MnO	CdO	Fe2O3	Al ₂ O ₃	SiO ₂	SiO ₂ /Al ₃
1	0-25	0.01	0.01	0.13	0	11.07	14.47	43.94	3.03
	25-50	0.02	0.01	0.15	0	11.51	15.00	45.35	3.02
2	0-20	0.00	0.01	0.14	0	10.17	13.3	46.20	3.40
	0-30	0.01	0.01	0.16	0	11.06	14.16	45.95	3.20
5	30-60	0.02	0.01	0.16	0	11.22	14.95	48.00	3.20
	0-30	0.00	0.01	0.16	0	10.85	14.60	48.06	3.20

Concerning soil fertility, data of available nitrogen ranges from 10.08 to 50.4 ppm in these soils, according to Dahnke and Johnson (1990) these soils have low levels of available nitrogen. Available phosphorus ranges from 1.1 to 12.6 ppm. With respect to available potassium, it ranges from 253.7 to 868.4 ppm. According to the index value reported by Soltanpour and Schwab (1977), available phosphorus and potassium occur at low levels, and they are insufficient for plant growth.

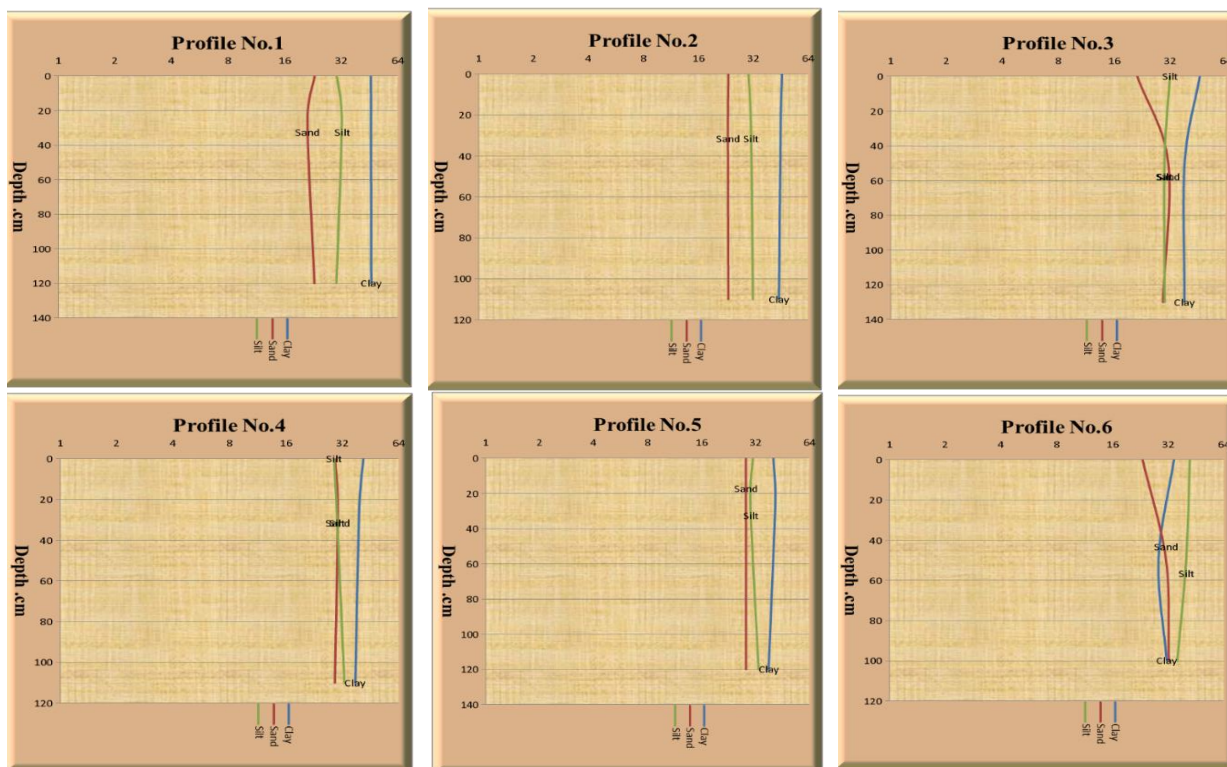


Fig. 2. Vertical distribution of sand, silt and clay.

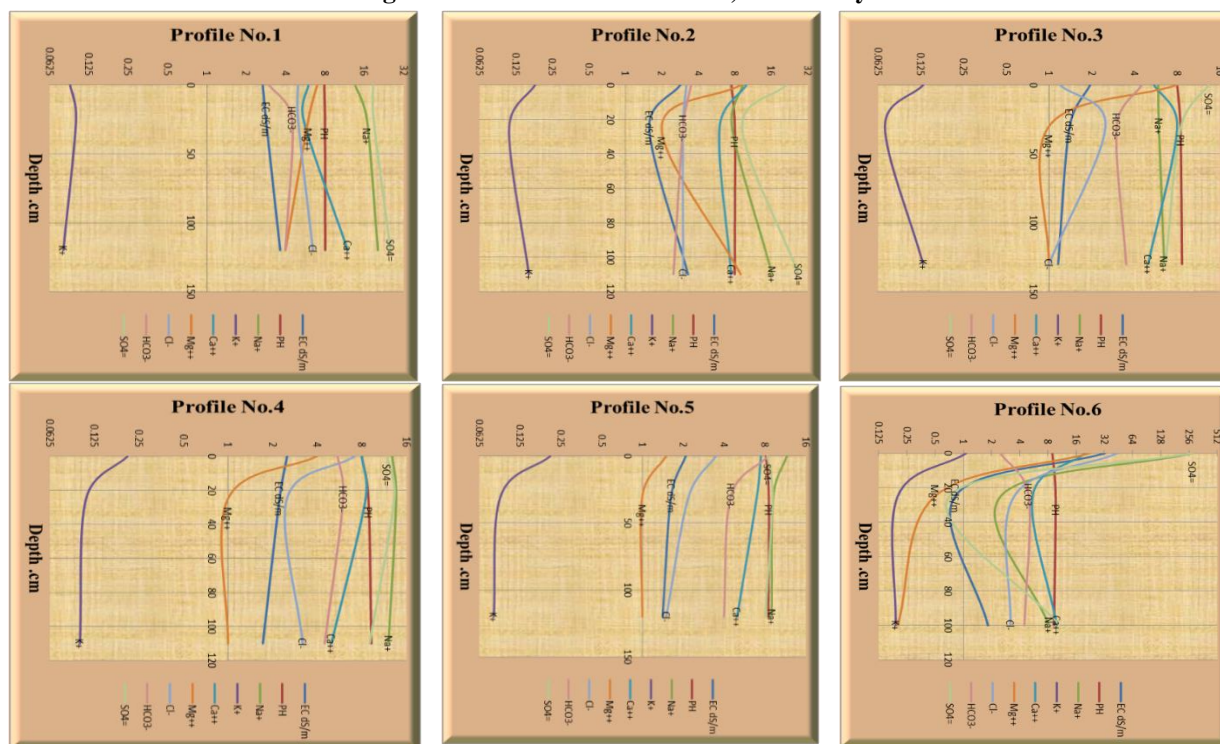


Fig. 3. Vertical distribution of EC dS.m⁻¹, pH, cations and anions.

Table 6. The specific adsorption of Mn, Na-acetate.

Profile No.	depth cm	The specific adsorption of Mn, Na-acetate. (meq l ⁻¹)			Clay%	CEC	CaCO ₃ %	OM%
		0	0.004	0.008				
1	0-25	0	1.95	3.88	5.78	46.2	45.4	4.6
	25-50	0	1.91	3.84	5.75	46.3	50.9	5.5
2	0-20	0	1.93	3.88	5.82	46.2	51.3	7.3
	20-60	0	1.92	3.85	5.78	45.4	48.6	8.7
3	0-30	0	1.93	3.88	5.81	46.5	45.1	6.9
	30-55	0	1.92	3.85	5.77	38.5	51.6	3.6
4	0-25	0	1.94	3.87	5.83	41.6	49.4	11.5
	25-50	0	1.92	3.85	5.78	39.5	45.3	7.3
Mean		0	1.92	3.86	5.79	43.8	48.5	7

The previous results showed of specific adsorption of manganese and cadmium ions in the presence of sodium. as a monovalent cation and calcium as a divalent cation. As shown on the graph (Fig. 7, 8, 9 and 10) (Fig. 7a and 8a) that the higher the added concentration, the higher the specific adsorption as straight line equation on for manganese and cadmium, while the role of Sodium as a single cation helps the adsorption of manganese and cadmium the superficial layers rather than the sub-surface layers due to the presence of organic matter and clay content, Senia Mellouk et al. (2011). In the presence of calcium, the specific

adsorption of manganese and cadmium decreases, as calcium occupies all exchange sites on the adsorption complex as a binary cation. However in the presence of calcium The adsorption increased in the surface layers than in the sub-surface layers due

to the presence of organic matter and clay content in the surface layer than the sub-surface layer Cavallaro and McBride (1978) McBride (1980).

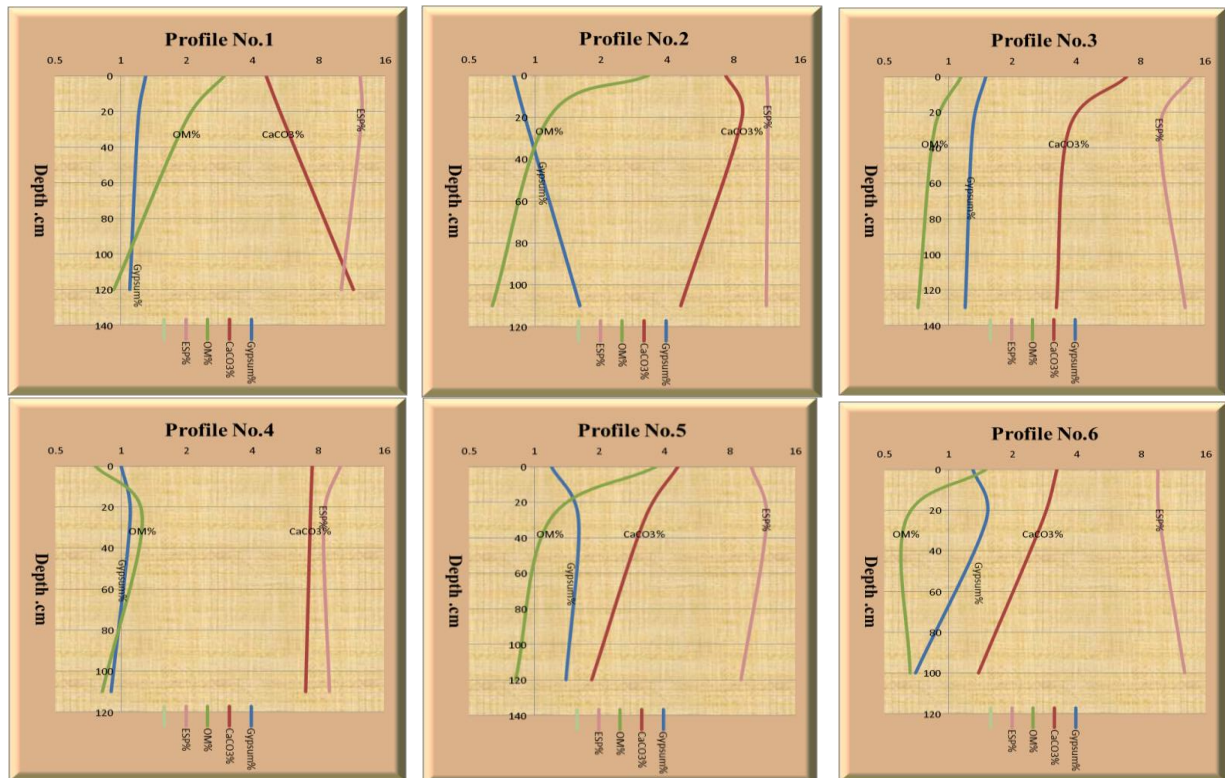


Fig. 4. Vertical distribution of %OM, %CaCO₃, gypsum and ESP.

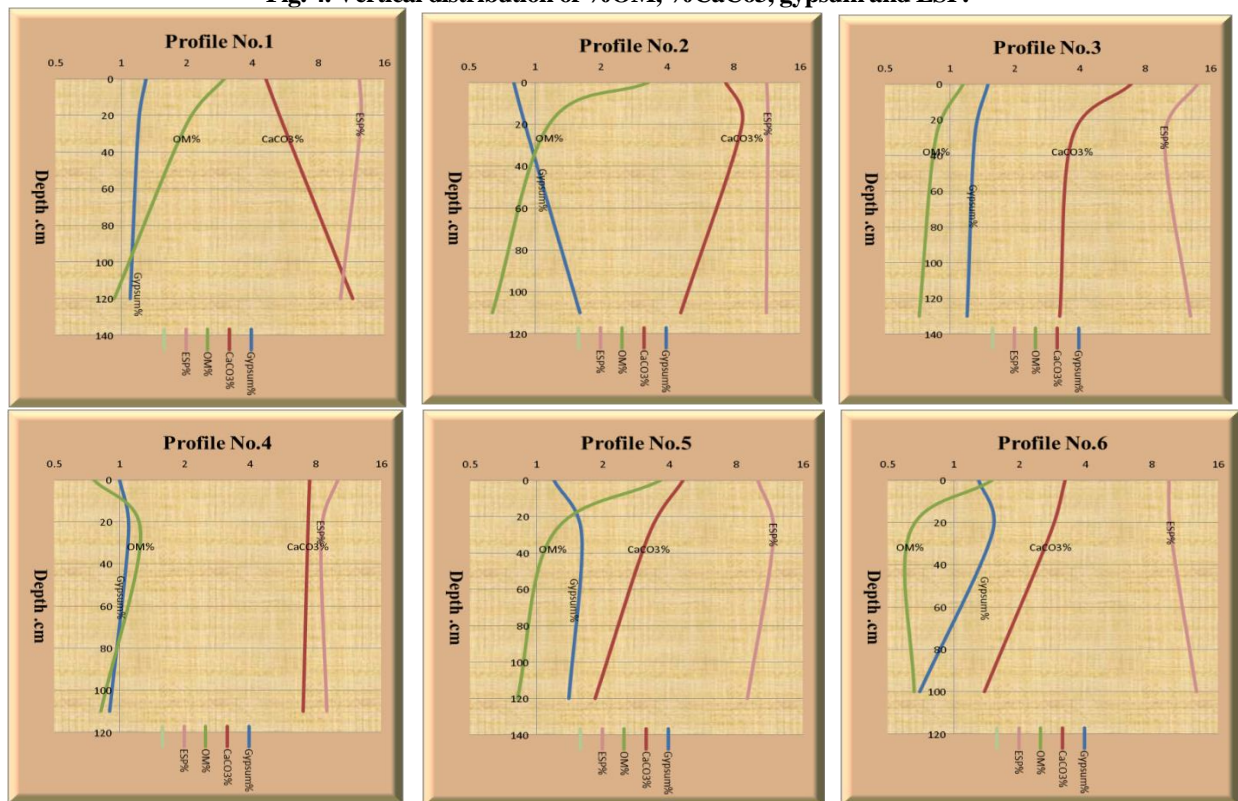


Fig. 5. Vertical distribution of ion exchangeable and CEC.

Specific adsorption in the presence of Na- dominance:

The specific adsorption of manganese and cadmium was measured by shaking 10 gm soil for 24hrs with 50ml Na-acetate (1.N) pH 8 solutions containing (0.0 ,0.004, 0.008 and

0.012) meq / l Mn (the same with Cd), McLaren and Crawford (1973). Once in solution Mn as well as Cd was determined by (ASS) Atomic absorption spectrophotometer.

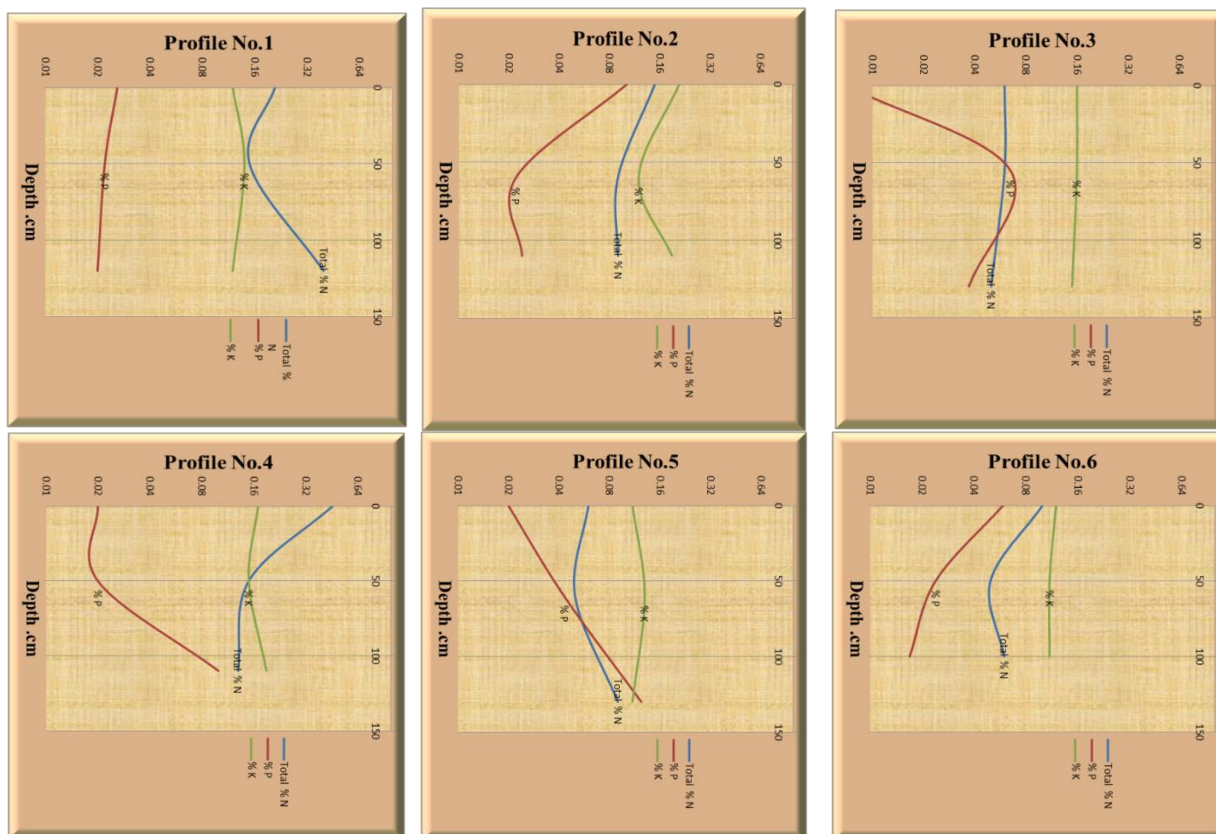


Fig. 6. Vertical distribution of total NPK.

Table 7. The specific adsorption of Mn, Ca-acetate.

Profile No.	depth cm	The specific adsorption of Mn, Ca-acetate. (meq/l)							
		0	0.004	0.008	0.012	Clay%	CEC	CaCO ₃ %	OM%
1	0-25	0	1.36	2.93	4.68	46.2	45.4	4.6	2.1
	25-50	0	1.52	3.28	5.17	46.3	50.9	5.5	1.9
2	0-20	0	1.10	3.13	4.77	46.2	51.3	7.3	3.2
	20-60	0	1.64	2.76	5.07	45.4	48.6	8.7	1.1
3	0-30	0	1.34	3.28	5.12	46.5	45.1	6.9	1.1
	30-55	0	1.55	3.20	4.86	38.5	51.6	3.6	0.8
4	0-25	0	1.50	3.46	4.23	41.6	49.4	11.5	0.7
	25-50	0	1.53	3.37	5.38	39.5	45.3	7.3	1.2
Mean		0	1.44	3.18	4.91	43.8	48.5	7	1.7

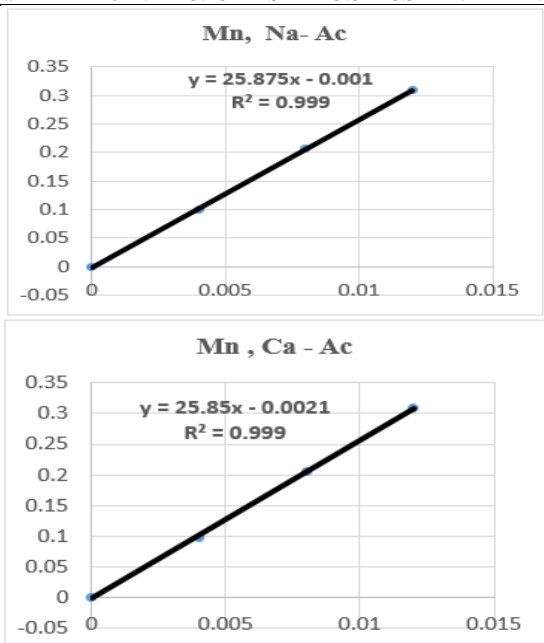


Fig. 7. The specific adsorption of Mn in presence of Na- and Ca-Acetate.

Specific adsorption in the presence of Ca- dominance:

The same as the aforementioned experiment was carried out using Ca- acetate (1.N) pH 8 solutions.

For the adsorption and desorption experiments of manganese and cadmium, the data obtained show the following.

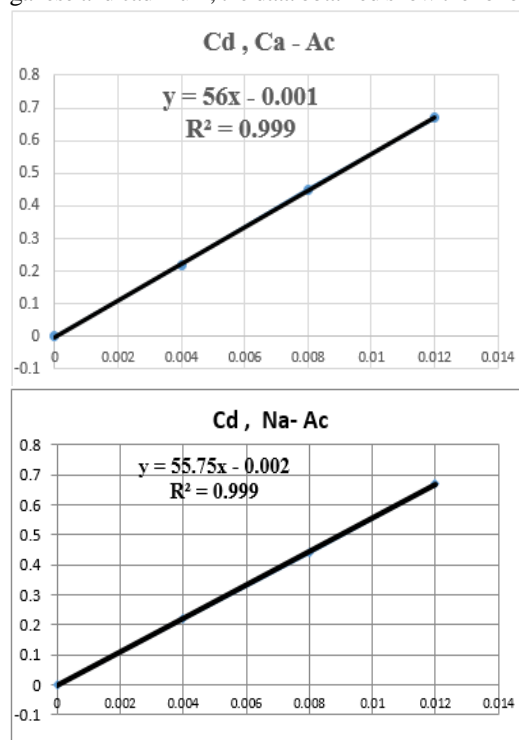


Fig. 8. The specific adsorption of Cd in presence of Na- and Ca-Acetate.

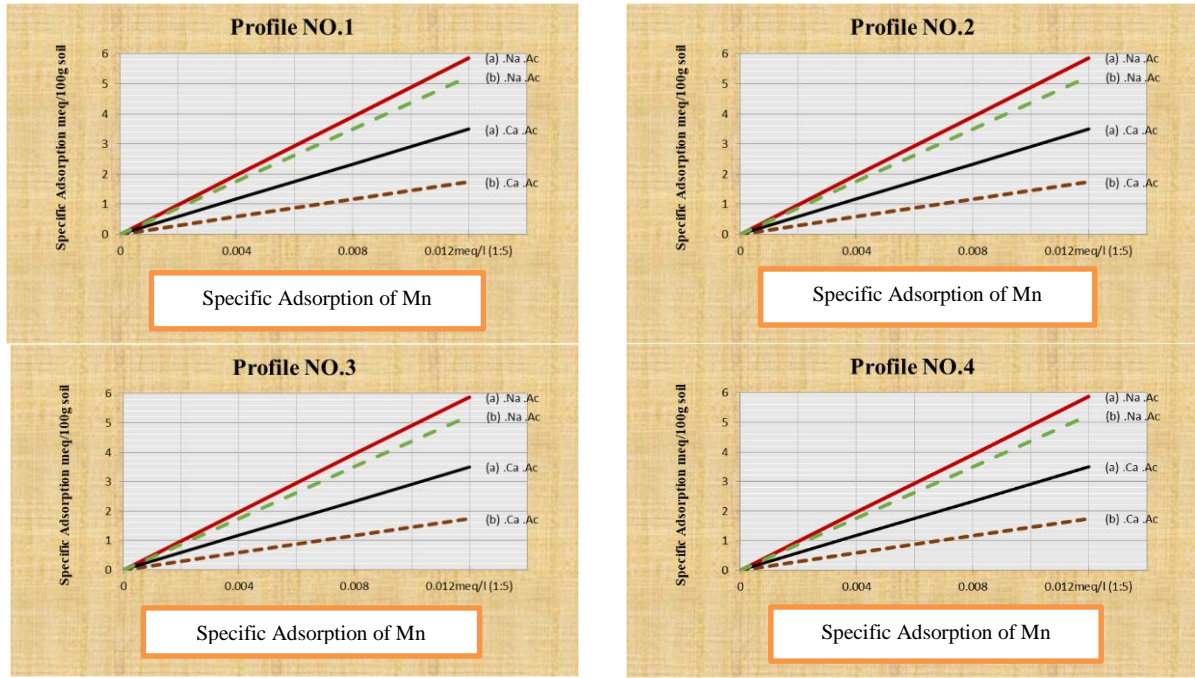


Fig 7.a. The specific adsorption of Mn (meq/100g soil) from Mn ions added to 1N PH8 Na and Ca-acetate. Solutions (1:5).
 (a) Surfes layer
 (b) Subsurfes layer

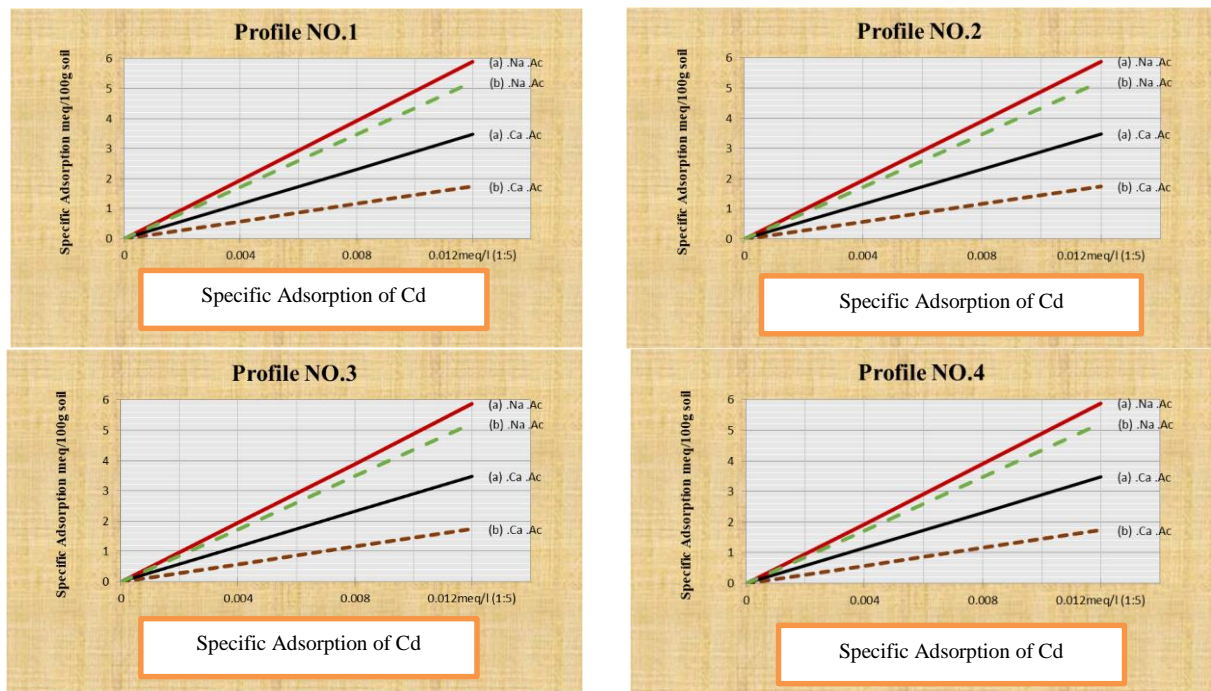


Fig. 8.a. The specific adsorption of Cd (meq 100g⁻¹ soil) from Cd ions added to 1N pH 8 Na and Ca-acetate. solutions (1:5).

Table 8. The specific adsorption of Cd, Na-acetate.

Profile No.	Depth cm	The specific adsorption of Cd, Na-acetate. (meq l ⁻¹)				Clay%	CEC	CaCO ₃ %	O.M%
		0	0.004	0.008	0.012				
1	0-25	0	1.29	3.04	5.31	46.2	45.4	4.6	2.1
	25-50	0	1.61	3.56	4.44	46.3	50.9	5.5	1.9
2	0-20	0	1.56	3.30	4.70	46.2	51.3	7.3	3.2
	20-60	0	1.64	3.56	4.44	45.4	48.6	8.7	1.1
3	0-30	0	1.57	3.18	4.79	46.5	45.1	6.9	1.1
	30-55	0	1.56	2.78	4.26	38.5	51.6	3.6	0.8
4	0-25	0	1.60	3.22	5.49	41.6	49.4	11.5	0.7
	25-50	0	1.54	3.48	4.86	39.5	45.3	7.3	1.2
Mean		0	1.54	3.26	4.79	43.8	48.5	7	1.7

Table 9. The specific adsorption of Cd, Ca-acetate.

Profile No.	depth cm	The specific adsorption of Cd, Ca-acetate. (meq l ⁻¹)				Clay%	CEC	CaCO ₃ %	O.M%
		0	0.004	0.008	0.012				
1	0 - 25	0	1.30	3.14	4.71	46.2	45.4	4.6	2.1
	25 - 50	0	1.21	3.40	4.36	46.3	50.9	5.5	1.9
2	0 - 20	0	1.39	3.31	5.23	46.2	51.3	7.3	3.2
	20 - 60	0	1.41	3.05	4.88	45.4	48.6	8.7	1.1
3	0 - 30	0	1.30	3.49	5.15	46.5	45.1	6.9	1.1
	30 - 55	0	1.04	3.22	5.06	38.5	51.6	3.6	0.8
4	0 - 25	0	1.28	3.66	5.25	41.6	49.4	11.5	0.7
	25 - 50	0	0.73	1.96	4.36	39.5	45.3	7.3	1.2
Mean		0	1.21	3.15	4.88	43.8	48.5	7	1.7

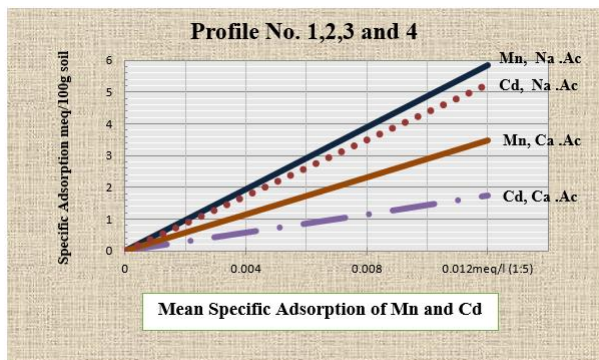


Fig. 9. Mean specific adsorption of Mn and Cd (meq 100g⁻¹ soil), as Mn and Cd -ions was added to 1N pH8 Na- and Ca-acetate, solutions (1:5).

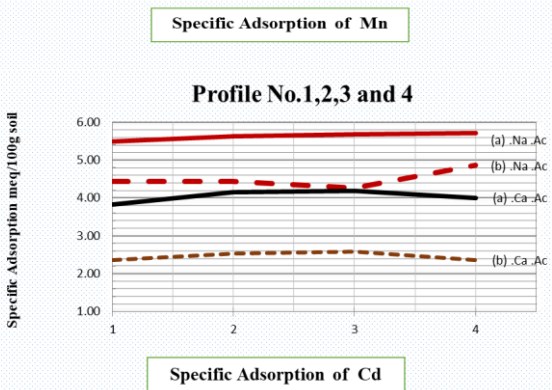
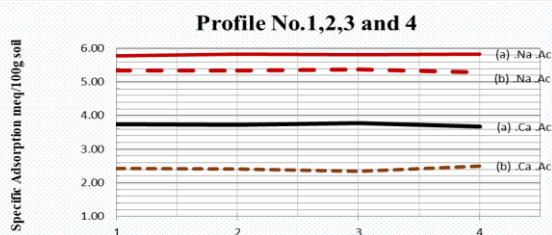
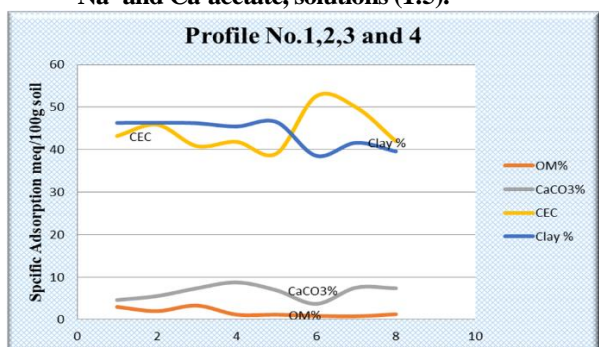


Fig. 10. Effect of some soil characteristics on Mn and Cd-specific adsorption using 0.012 meq l⁻¹ Mn and Cd in solutions Na and Ca-acetate PH8.

Refer to the effect of sodium on the absorption of manganese and cadmium. The same trend was found in the topsoil as well as in the subsurface soil samples. This confirms that the organic matter in the top soil plays a role towards the adsorbed manganese and cadmium specifically.

REFERENCES

Berkowitz, B., I. Dror, and B. Yaron. (2008). Contaminant Geochemistry: Interactions and Transport. *In: The Subsurface Environment*. Springer, Heidelberg, 412 pp.

Bower, C. A. (1959): Chemical amendments for improving sodium soils. *Agric. Information Bull.* 195, U. S. Department of Agric., 9p.

Cavallaro, N. and McBride, M. B. (1978). Copper : cadmium adsorption characteristics of selected acid and calcareous soils. *Soil Sci. Soc. Am. J.*42: 550- 556.

Chapman, H. D. and P. F. Pratt 1982. *Methods of Analysis for Soil Plant and Water*. Priced publication 4034, University of California, Division of Agric. Sci.

Christensen, T.H. (1984). Cadmium soil sorption at low concentration. *Water, Air, and Soil Pollut.* 21:105

Dahlin, C.L., C.A. Williamson, W.K. Collins, and D.C. Dahlin. (2002) Sequential extraction versus comprehensive characterization of heavy metal species in brownfield soils. *Environ. Forensics.* 3: 191-201.

Dahnke, W.C. and G.V.Johnson.)1990(: Testing Soils for Available Nitrogen, *In: Soil Testing and Plant Analysis*, 3rd ed., SSSA Book Series No.3, R.L. Westerman (ed.). Madison, WI: Soil Science Society of America, 127-139.

FAO Soil Bulletin 1989. *Soil and Plant Testing.* 38/2 250P.

Filgueiras, A.V., I. Lavilla, and C. Bendicho. (2002). Chemical sequential extraction for metal portioning in environmental solid samples. *J. Environ. Monit.* 4: 823-857.

HASSAN, S, A. (2017) Micromorphological study of some soil groups of Egypt. M. Sc. Thesis, Fac. of Agric Al-Azhar Univ Cairo. Egypt.

Huber, D.M. (1980). The role of mineral nutrition in defense Pp. 381-406 *In Plant disease, an advanced treatise*, 5: How plants defend themselves.

Jackson. M. L. (1963): *Soil Chemical Analysis*. Constable and Co.Ltd., England.

James, R.O. and Barrow, N. J. (1981).Copper reactions with inorganic components of soils including uptake by oxide and silicate minerals. *In Copper in Soils and Plants (J.F., Ioneragan, A.D. Robson and R.D. Grahon, eds.):*.47-68. Academic press, New York, U.S.A.

- Kalmykova, Y., Strömwall, A. M., & Steenari, B. M. (2008). Adsorption of Cd, Cu, Ni, Pb and Zn on Sphagnum peat from solutions with low metal concentrations. *Journal of Hazardous Materials*, 152(2), 885-891.
- Khaokaew, S., R.L. Chaney, G. Landrot, M. Ginder-Vogel, and D.L. Sparks. (2011). Speciation and release kinetics of cadmium in an alkaline paddy soil under various flooding periods and draining conditions. *Environ. Sci. Technol.* 45 (10):4249-4255.
- McBride, B.M.(1980). Chemisorption of Cd²⁺ on calcite surface. *Soil Sci.*
- McLaren, R.G. and Crawford, D.V.(1973). Studies on soil copper. II. The specific adsorption of copper by soil. *J. Soil Sci.*, 24:443-452.
- McLean, J. E. and Bledsoe, B. E. (1992). 'Behaviour of metals in soils". Ground Water Issue, U. S. EPA. 540-S-92-018.
- Mehta. C.S, Poonia, R.S. and Rajpal. (1984). Adsorption and immobilization of zinc in calcium and sodium saturated soil from semi-arid region, Ind. *J. Soil Sci.*, 137:108-114.
- Mellouk, S., Belhakem, A., Marouf-Khelifa, K., Schott, J., & Khelifa, A. (2011). Cu (II) adsorption by halloysites intercalated with sodium acetate. *Journal of colloid and interface science*, 360(2), 716-724.
- Mulvaney, R.L., (1996). Nitrogen – Inorganic forms. p. 1123-1184. In: Sparks, D.L. (ed.) *Methods of Soil Analysis. Part 3. Chemical Methods.* SSSA Book Series No. 5. SSSA and ASA, Madison, WI.
- Pendias, K. and Pendias, A.K. (1992). *Trace Elements in Soils and Plants*, 2nd ed. C.R.C press, Boca Raton, 365.
- Raikhy, N. P. and Takkar, P.N. (1983). Zinc and copper adsorption by a soil with and without removal of carbonates. *J. Ind. Soc. Soil Sci.*, 31 : 611-614.
- Richards, L.A. (Ed.) (1954). *Diagnosis and Improvement of Saline and Alkali Soils.* U.S.D.A. Hand Book No. 60. Soc. Am. J., 44: 26-29.
- Soil Survey Staff (2006) *Keys to Soil Taxonomy* 10th Edition. USDA-NRCS
- Soltanpour, P. N., and Schwab A.P. (1977): A new soil test simultaneous extraction of macro- and micro-nutrients in alkaline soils. *Comm.*, in *Soil Sci. and Plant Anal.*, 83: 195-207.
- USDA (2004). *Soil Survey Laboratory Methods Manual. Soil Survey Investigation Report No.42, Version 4.0.*
- USDA, (1975). *Soil Taxonomy. A basic system of soil classification.* Agri. Handbook No. 436. Washington D. C.
- USDA, (2012). "Field Book for Describing and Sampling Soils" National Resources Conservation Service (NRCS), United State Department of Agriculture. September 2012. Version3.

الأدمصاص النوعي للمنجنيز والكاديوم في التربة شمال شرق دلتا النيل حسن علي أحمد ، صلاح ابو العينين ، توفيق مسلم و أمير سامي حسان قسم الاراضى والمياه كلية الزراعة جامعة الأزهر _ القاهرة

تناولت هذه الدراسة تأثير خواص التربة على إدمصاص المنجنيز والكاديوم في اراضى شمال شرق دلتا النيل وقد أجريت هذه الدراسة على عينات التربة السطحية وتحت السطحية في سبعة قطاعات ذات الطبيعة للاراضى الطينية الثقيلة: حيث تهدف هذه الدراسة إلى إلقاء الضوء على تأثير خواص التربة على إدمصاص المنجنيز والكاديوم ولتحقيق هذا الهدف تمت دراسة تفصيلية على الخواص الطبيعية والكيميائية لعينات التربة السطحية وتحت السطحية. ثم بعد ذلك تم إجراء تجربة الإدمصاص النوعي انطلاقاً للمنجنيز والكاديوم. تم في هذه التجربة استخدام محلول خلات الصوديوم وخلات الكالسيوم 1 عياري وحضرنه 1 عياري من كلوريد النحاس ثم 1 عياري من كلوريد الزنك وعمل سلسلة من التركيزات من كلاهما (0 - 0.004 - 0.008 - 0.012). مع تثبيت قيم رقم حموضة المحلول على 8 PH والمضاف إلى 10 جرام تربة من عينات التربة السطحية وتحت السطحية مع التقليب وتركه لمدة 24 ساعة ويتم التقدير باستخدام جهاز امتصاص الطيف الذري وأوضحت النتائج أنه بزيادة التركيز زاد الإدمصاص سواء المنجنيز والكاديوم. وذلك عند كل تركيز. و يرجع ذلك الى وجود الصوديوم ككاتيون أحادي يعمل على زيادة التبادل على معقد الأدمصاص بخلاف الكالسيوم. قد يكون هذا بسبب حقيقة أن زيادة رقم الأس الهيدروجيني يزيد من الشحنات السالبة عن طريق زيادة (OH) وبالتالي زيادة الشحنات السالبة. اوضحت النتائج السابقة في دراسته الأدمصاص النوعي على أيونات المنجنيز والكاديوم في وجود الصوديوم ككاتيون أحادي والكالسيوم ككاتيون ثنائي وكما هو موضح على رسم البياني انه كلما زاد التركيز زاد الأدمصاص النوعي كما هو موضح بمعادلة الخط المستقيم على الشكل البياني رقم 7 و 8 بالنسبة للمنجنيز والكاديوم بينما كان دور الصوديوم ككاتيون احادي يساعد على ادمصاص المنجنيز والكاديوم في الطبقات السطحية على عن الطبقات تحت السطحية نظرا لوجود المادة العضوية ومحتوى الطين بينما في وجود الكالسيوم قل الأدمصاص النوعي سواء للمنجنيز او الكاديوم حيث ان الكالسيوم يشغل جميع مواقع التبادل على معقد الأدمصاص ككاتيون ثنائي و في وجود الكالسيوم زاد الأدمصاص في الطبقات السطحية عن الطبقات تحت السطحية نظرا لوجود المادة العضوية ومحتوى الطين في الطبقة السطحية عن الطبقة تحت السطحية. وعلى ذلك فإنه على ضوء هذه الدراسة يلزم الحذر الشديد من التلوث بالمنجنيز والكاديوم في الأراضى المرتفعة في نسبة الطين أو السعة التبادلية الكاتيونية وكذلك في الأراضى القلوية لما في ذلك من خطر شديد على كلا من النبات والإنسان والحيوان.