Effect of Intermittent leaching on Behavior of Magnesium and Sodium Ions in sabkha soil for selected regions in central Iraq

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ABSTRACT

The study was conducted in order to determine the effect of intermittent leaching on the behavior of magnesium and sodium ions in sabkha soil compared to the other main ions. Three locations were selected from the soil of central Iraq (Yusufiyah/Baghdad, Al-Shomali/Babylon, Al-Shamia/Al-Diwaniyah). The soil was characterized by the high electrical conductivity between (131.48 - 206.92 dS m^{-1}), low pH and it is characterized by dark brown color. The chemical traits for the main ions were estimated where observed a reduction in the electrical conductivity values in the final leaching, ranging from 3.12 $dS.m^{-1}$ to 4.71 $dS.m^{-1}$ and a high soil pH. The speed coefficient of leaching for Magnesium ion, It was found that it occupies an intermediate position between sodium and calcium ions. The results of the study showed the predominance of magnesium chloride salts in sabkha soils and sodium chloride in Yusufiyah soils, which are in transition from Shoura to Sabkha because they contain a high percentage of magnesium chloride.

أثر الغسل المتقطع على سلوكية أيوني المغنيسيوم والصوديوم في ترب السبخة لمناطق مختارة وسط العراق

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الملخص

أجريت الدراسة بهدف معرفة أثر الغسل المتقطع على سلوكية أيوني المغنيسيوم والصوديوم في ترب السبخة مقارنة بالايونات الرئيسية الاخرى، اذ تم اختيار ثلاث مواقع من ترب وسط العراق (منطقة اليوسفية / بغداد - ناحية الشوملي/ بابل – ناحية الشامية / ديوانية)، اذ تميزت الترب بتوصيلها الكهربائي العالي بين 131.48- 206.92 ديسي سيمينز $م^{-1}$ ودرجة تفاعل منخفضه وتميزت بلونها البني الغامق، وتم تقدير الصفات الكيميائية للايونات الرئيسية اذ لوحظ انخفاض في قيم التوصيلية الكهربائية في رواشح الغسل النهائية اذ تراوحت بين 3.12–4.71 ديسي سيمينز $م^{-1}$ وارتفاع في درجة تفاعل التربة وتم تقدير معامل سرعة الغسل ايون المغنيسيوم ووجد انه يحتل موقعا وسطيا بين ايوني الصوديوم والكالسيوم ، واذ لوحظ من خلال نتائج الدراسة سيادة املاح كلوريد المغنيسيوم في الترب السبخة وكلوريد الصوديوم في تربة اليوسفية وهي في مرحلة انتقالية من الشورة الى السبخة لكونها تحتوي على نسبة عالية من كلوريد المغنيسيوم .

1. INTRODUCTION

The Middle Euphrates region is considered from dry and semi-dry areas, it is affected by salinity deposition. Magnesium, sodium and their salts are considered common ions and salts in it. Magnesium ion has a small ionic diameter amount to 0.078 nm, which is less than sodium (0.098 nm), therefore behaves differently to bivalent positive ions and approaches the behavior and effect of sodium ion (7). Some studies have been conducted on the soils of sabkha and Al-Shoura soils since this group of soils can differ in terms of the causes and nature of salinity and the type of salts accumulated in it compared to Al-Shoura soils. The results of the studies showed that they do not differ significantly in terms of chemical, mineral and saline traits. They differ in terms of nature, salinity stage and hydrological conditions only. Sabkha represents an advanced saline stage from salinity process. The salinity process is characterized by large fluctuations in the level of groundwater during the seasons. The sabkha is often found in the saline soil itself, which is a transitional stage from Al-Shoura to Al-Sabkha, and that the sabkha soil was characterized by its good response to leaching operations (2, 5).

2. MATERIALS AND METHODS

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Some of the chemical and physical traits of soil samples were estimated in Table (1) according to the methods described by (Ricards, Welkaly and Black (6); Drouineau and Galet (9). The experiment was conducted on three locations of soils in central Iraq (Yusufiyah, Al-Shomali, Al-Shamia). An experiment was conducted on it to detect the behavior of leaching magnesium ion compared to other ions using distilled water for the purpose of washing salts. where columns were taken with a diameter of 5 cm and a length of 30 cm, filled with soil weighing 250 g and served with a 2 mm sieve, washed the soil columns with distilled water and on the basis of pore size and the process was repeated several times until the value of electrical conductivity in the washing filters reduce to less than 5- 4 $dS.m^{-1}$, Some of the main chemical traits of the final filtration were estimated. The speed rate of leaching for Magnesium ions and main ions was calculated using the proposed formula by (8) as follows:

$$\text{The speed rate of leaching for Magnesium ions} = \frac{\text{The Concentration of the ions in the soil after leaching}}{\text{The Concentration of the ions in the soil before leaching}} \quad (1)$$

The pore size of each soil column was calculated as mentioned by (10) according to the equation:

$$Pv_w = W_S - \Delta_S \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where

Pvw: means the measured pore size from the difference in the water mass (cm^3).

WS: means the mass of column soil after saturation (g).

SS: means the mass of dry column soil in the oven (g).

Table 1: Some chemical and physical traits of soil samples

Location	EC ($dS.m^{-1}$)	pH	Main dissolved ions ($mmol.L^{-1}$)								Lime ($g.kg^{-1}$)	Gypsum ($g.kg^{-1}$)	CEC ($C mol cal. kg^{-1}$)	Organic matter ($g.kg^{-1}$)	Soil texture
			Ca^{2+}	**Mg^{2+}**	**Na^{1+}**	**K^{1+}**	**CO_3^{2-}**	**HCO_3^{1-}**	**SO_4^{2-}**	**Cl^{1-}**					
Yusufiyah	131.48	7.16	16.12	108.75	1184.11	2.82	NIL	11.60	92.45	1207.75	270.42	25.16	15.38	12.62	Silty clay
Al-Shomali	188.51	7.12	28.40	385.96	1466.20	2.72	NIL	7.25	184.91	1691.12	236.15	7.64	18.16	17.28	Silty loam
Al-Shamia	206.92	7.08	81.92	528.63	1456.17	1.68	NIL	9.16	104.51	1954.73	248.27	8.35	18.44	19.16	Clay

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3. RESULTS AND DISCUSSION

Table (2) showed a significant decrease in the values of the electrical conductivity in the final leaching filtration after leaching compared to its pre-leaching value, where the electrical conductivity value of the study soil ranged from 131.48 to 206.92 $dS.m^{-1}$ and then decreased after repeating the process of the addition of water as much as the size of the pores until the values of electrical conductivity in the final leaching filtration was less than 5-4 $dS.m^{-1}$, the values of the electrical conductivity of the final leaching filtration for the study soil columns ranged between 3.12 - 4.71 $dS.m^{-1}$. The first stages of leaching are the washing and removal of salts that are easy to dissolve and are present in the large pores. The mechanical load plays a major role in this stage. In the final stages of leaching, the low solubility salts and the salts existing in the small pores (1, 2, 4) are leached. As for soil pH, When the soil leaching we note that there is a slight increase in the values of the soil pH is due to a significant decrease in the concentration of salts during the leaching process, this result agrees with (3). We conclude from the results of Table (3) that magnesium ion occupies an intermediate position between cations between calcium and sodium ions $Na^{+1} > Mg^{+2} > Ca^{+2}$. This is due to the fact that magnesium behaves the behavior of sodium because its water envelope is large, therefore the percentage of adsorption less than calcium on the surface of soil particles. As for salts in the study soil, we observe the predominance of magnesium chloride salts in sabkha soils and sodium chloride in Yusufiyah soils, which are in transition from Shoura to Sabkha because they contain a high percentage of magnesium chloride.

Table 2: Some chemical traits of soil samples before and after leaching.

Location	Before leaching						After leaching					
	EC ($dS.m^{-1}$)	pH	Main dissolved ions ($mmol.L^{-1}$)				EC ($dS.m^{-1}$)	pH	Main dissolved ions ($mmol.L^{-1}$)			
			Ca^{2+}	**Mg^{2+}**	**Na^{1+}**	**Cl^{1-}**			**Ca^{2+}**	**Mg^{2+}**	**Na^{1+}**	**Cl^{1-}**
Yusufiyah	131.48	7.16	16.12	108.75	1184.11	1207.75	3.12	7.84	11.85	9.97	1.02	1.40
Al-Shomali	188.51	7.12	28.40	385.96	1466.2	1691.12	3.46	7.81	8.76	14.61	2.54	3.68
Al-Shamia	206.92	7.08	81.92	528.63	1456.17	1954.73	4.71	7.76	14.94	23.80	2.92	5.18

Table 3: The speed rate of leaching the main ions in the leached sabkha soils.

Location	Main dissolved ions ($mmol.L^{-1}$)			
	Ca^{2+}	**Mg^{2+}**	**Na^{1+}**	**Cl^{1-}**
Yusufiyah	0.7351	0.0917	0.0009	0.0012
Al-Shomali	0.3085	0.0379	0.0017	0.0022
Al-Shamia	0.1824	0.0450	0.0020	0.0026

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