The Physical And Chemical Properties Of Soils For Environments Of Three Different Land / Iraq

1Iman S. M. Alhashimi, 2Riad A. Abdul-Jabbar, 3Salman K. Issa

1Ministry of Education / Salah Al-Din Education Directorate
2Tikrit University / College of Science
3University of Baghdad/ College of Sciences agricultural engineering
imebio@gmail.com

Abstract

The current study performed for the period of March 2019 to February 2020 on three different land ecosystems in three Iraqi governorates which are Sulaymaniyah, Kirkuk, and Anbar. The samples of soil are collected from nine stations that close to the pollution sources. The stations are Bazian cement plant, North Oil concentration area, the main street in the modern desert which located between longitude and latitude of (45.062554-35.577087), (44.217077-34.406426), (42.269622-34.8764) respectively. Some physical and chemical factors for soils are studied where their values ranged from the electrical conductivity of (0.13 - 2.86 EC dS/m), pH (7.21 - 7.97), organic matter of (0.31 - 10.89 g/kg), the total calcium carbonate of (164.16 - 390.10 g / kg), and the positive exchange capacitance of (3.03- 25.82 (centimol+/Kg-1)). While values of the exchanged positive ions are ranged (Ca+2, Mg+2, Na+1 and Potassium K+2) ((0.10 (-8.43) and (1.0 -0.01), (1.93- 0.04), (0.04). (3.79 - cimmol/kg) respectively. Whereas the values of the dissolved positive ions (Ca+2, Mg+2, Na+1 and Potassium K+1) are recorded (0.03- (3.61, (1.82-0.01), (0.01-0.67), 0.55-0.01)) /L respectively. As for negative ions, their values are recorded (dissolved bicarbonate HCO3- and dissolved chlorine (Cl-1 (0.09 (1.65-, 0.76-0.05)) centimol/L).

1.Introduction

Pollution is one of the major problems that the humans face it. Also, it one of the most important challenges which facing biotechnology and genetic engineering. It needs planned and concerted efforts in order to address and reduce it. Among the things which complicated this problem is the human that has the great role in increasing its gravity through his various activities which threatening his life. In addition to its effect on another living creatures which results in the change of the natural balance of environment and its various living and non-living components (Khan, et al., 2011).

The industrial revolution that spread throughout the world participated in the destruction of environment and its features. When the human being replaced by the machine, and he replaced the primitive

methods with more sophisticated and modern methods. It also used the steam engines that need new sources of fuel, such as carbon and petroleum. In addition to that, the nuclear
energy which resulted in burning of carbonaceous materials. Furthermore, the fumes rising from the toxic chemical industries on large green areas and destruction of the nearby forests and weeds (Zhang et al., 2012).

Yogendra et al. 2013 pointed the multiplicity of resources of environmental pollution which including the natural, physical, chemical, or biological pollutants. The resource of pollution may be technological and industrial pollutants that resulting from a development of technologies, discoveries, innovations, and finally from the human and animal pollutants which represented by craps that produce as a result of their daily activities. Whereas the soil pollution defines as the degradation that affects the soil and changing its physical, chemical and biological characteristics. Also, it changing the properties in such a way that it negatively affects the people, animal and plant which living above its surface in directly or indirectly manner. The pollution that caused by an oil is one of the most common types of pollution which the surrounding areas are suffer from it, where the oil flows into the soil through the factories and oil recurring plants or through what falls on it from carbon fumes that mixed within the rain or fog particles fall or form near soil surface in the agricultural areas (Mahsoub and Aarab, 2002). The geological and topographical nature and the rock formations have an important influence in determining the nature of stations. Many researchers have shown an interest in the soil pollution, and also many studies and research have emerged.

Al-Anbari et al. in 2013 stated that there are a relationship between the environmental pollution and the energy. It operates the conventional electric power that use the scorbutic fuel sources in order to generate the electricity. Generally, the soil receives many things from a variety resources including the emissions from factory chimneys, electric power generators, oil processing and refining units, etc. (Awadh, 2013). Gharaybeh in 2010 asserted that the pollution is a state of destruction of the soil horizon and a layer in which the roots and organisms grow in the soil. Healthy soils depend on the bacteria, fungus, and the young life in order to break down the waste that it contain and then it produce the plant nutrients. The pesticides may limit the ability of influencing the organisms to decompose the wastes. According to that, the farmers who overuse of the fertilizers and pesticides are destroying the productivity and capacity of the soil. The soil is the main container for the pollutants because it has the ability to bind various chemicals. These chemicals may available in different forms in the soil through different forces that keep it connected to the soil particles. The severity of a chemical toxicity depends on the form in which they are found as well as the soil changes. Some environmental properties such as the climate factors can alter the balance that present in the soil, and cause toxic elements such as the heavy elements which are tightly bound to the soil particles (Joudah, 2013). Several studies have shown that most soil pollutants contain a mixture of complexes of heavy elements and organic materials. Also, the source of these pollutants comes from the natural processes and human activity. Especially in recent years, the presence of these pollutants in a soil has become the matter of concern to the number of governments due to its impact on the human, animal and plant health (Naidu et al., 2010, Megharaj et al., 2012).

2. Study area

The Selection of Study Areas
Samples were collected seasonally with the exception of that the third station which is the desert of Haditha city, where its samples were not collected in the spring season due to the security reasons.

1. The first station in the Sulaymaniyah governorate: the mountainous area with the intensive trees near the Bazian cement plant located between longitude and latitude of (45.062554 _ 35.577087). This area was chosen because it is exposure to the pollutant emissions from Bazian cement factory. Whereas the air carries out the chemical pollutants and transports it to a nearby areas. The factory is located about 35 km to the west of the city center of Sulaymaniyah in an area that surrounded by the mountains, 860 meters above the sea level, and at the level very which is close to the location of resources of raw materials.

Samples are taken from three topographical regions from each region, with three replications:

**Study area**

**The Selection of Study Areas**

Samples were collected seasonally with the exception of that the third station which is the desert of Haditha city, where its samples were not collected in the spring season due to the security reasons.

1. The first station in the Sulaymaniyah governorate: the mountainous area with the intensive trees near the Bazian cement plant located between longitude and latitude of (45.062554 _ 35.577087). This area was chosen because it is exposure to the pollutant emissions from Bazian cement factory. Whereas the air carries out the chemical pollutants and transports it to a nearby areas. The factory is located about 35 km to the west of the city center of Sulaymaniyah in an area that surrounded by the mountains, 860 meters above the sea level, and at the level very which is close to the location of resources of raw materials.

Samples are taken from three topographical regions from each region, with three replications:

A. Up of the mountain: approximately, it rises from the area of the foot of mountain about 200 meters. This region is characterized by the dense of Quercus and oak trees. These trees are large and perennial trees, and may reach 500-2000 years. Three replicates were sampled and the distance between the replicates was approximately 250 meters.

B. foot of mountain: It is approximately 700-500 meters from the factory. Also, it distinguished by its evergreen trees with the dense leaves represented by the evergreen linden spatilia trees. The trees characterized by their height which are more than 10 meters. It is also distinguished by its complex and dense leaves. Three replicates were taken and the distance between each repeat is approximately 250 meters.

C. The depression or (the valley): It is a low area that approximately 100 m from the level of a region at the foot of mountain. This area is characterized by the presence of wild plants, grass and hawthorn trees sp Crataegus. Three replicates were taken with an estimated distance of 250 meters for each duplicate.

D. Taking the control of soil far from the resources of a pollution.
2. The second station in Kirkuk governorate: The North Oil Company's crude oil concentration unit which is located between longitude and latitude lines of (44.217077 - 34.406426). This plant was chosen for the study because it subjected to the contamination with the smoke and fumes emissions that resulting from the concentration and processing of the crude oil. Samples were taken from:

A. Land cultivated with the wheat plant.

B. Uncultivated land with some of wild plants.

C. Taking the control sample from an area that is not contaminated with any kind of pollutants.

Three replicates were taken from each site and the distance between each one was estimated approximately at 250 meters.

3. The third station in Anbar governorate: a Haditha desert which located between the longitudes and latitude of (42.269622 - 34.8764). It is an area that included sandy soils. Three replicates were taken with the distance between the repeaters being approximately 250 meters. It is characterized by the presence of sand dunes with no pollutants or industrial emissions in the area except for wheel emissions. There may be emissions from passing wheels.

A. The modern desert close to the main street which is the source of pollution from exhaust emissions of passing cars.

B. Control far from the main street.

Materials and methods

1. The field work: Samples are taken after skimming the top layer of soil to a depth of 1 cm. The sample was taken with a depth of 0-30 cm at the rate of three replications about 2-3 kilos of soil and stored in the polyethylene bags. These bags are marked with the name of the region and the date for the purpose of conducting the physical and chemical tests of the models by taking into account the direction of the winds.

Preparing soil samples for analysis

The soil samples intended for studying physical and chemical properties are transferred to the laboratory. Samples were dried and grinded by using the rubber mallet in order to avoid the contamination. Then, the samples were passed through the sieve with 2 mm holes. After that, it was collected in polyethylene bags which marked with the name of the sample and date of its collection. Then, it was stored in the laboratory for the purpose of performing the physical and chemical analyzes.

Soil physical and chemical analyzes

Soil tissue was estimated via using a hydrometer according to (Day, 1965) that described in (Black, 1965). Whereas, the organic material was estimated by the wet digestion method according to method of Walkley-Black which described in (Jackson, 1958). Determination of the cation exchange capacitance of CECs in the soil samples done according to (Savant, 1994).
method by saturating the sample using (1% Na2CO3) and correcting with Methylene blue with percentage of 0.4%. The degree of soil reaction (pH) was estimated with by using a pH-meter device in the soil extract 1:1 according to the methods which presented in (Page et al.,1982). Electrical conductivity (EC) was measured by using a conductivity meter in a 1:1 soil extract according to methods that presented in (Page et al., 1982). Total carbonate minerals estimated by a method of calculating the loss in CaCO3 through treating the soil with hydrochloric acid HCl(N3) as reported in (Richard, 1954). Determination of the exchanged positive ions, Na+ by using ammonium acetate (N1), while extraction of potassium (K+) with calcium chloride 0.5 M was estimated by using the flame photometer type AFB100 Biotech, Calcium and magnesium (Ca+2, Mg+2) are also measured by the titration with fluorescent. While the dissolved ions which includes the positive and negative ions in the soil extract 1:1 are estimated as follows: For the positive ions, the concentration of dissolved calcium and magnesium ions in the extract of soil was measured via using a correction method by fascinate and according to (Richard, 1954). Measuring the concentration of sodium and potassium ions in extract of soil using the Flame Photometer of Sp3000 according to (Page et al., 1982). The dissolved bicarbonate negative ions are measured in extract of soil by correcting it with sulfuric acid (N 0.01) as reported in (Page et al., 1982). The chlorine ions that dissolved in the extract of soil are determined by the method of the correction with silver nitrate as reported in (Black, 1965).

3.Results and discussion

Table (3) shows the results of analyzing the soil tissue of the study stations which the percentage of grittiness particles has exceeded the rest of separations in most soils. Especially in the third station (Haditha desert, Haditha control) that represented by the sand dunes which are of limited spread in this region. It is considered as a newly formed and poorly developed soil that consists of accumulated sand particles which are mainly transported from the Western desert by the wind. The reason for the difference in soil tissue may be due to the topographic location. In general, the nature of the soil in the first stations (high mountain) and the second (uncultivated land) with control soils was mixed - sandy loam. While the first station (the foot of the mountain, the valley) and the second station (cultivated land) was loam. Balamurugan et al., 2000 found in a site in India that the soils cultivated with eucalyptus had an increase in the clay and silt contents and decrease in the sand content. Khan et al., 2013 indicated that the soil clay content in soils affected by the water erosion during the rain were different. The highest content of mud was observed at the bottom of the mountain slope. That is, at the first station (the foot of the mountain, the valley) with an increase in the percentage of clay in the site of the valley and higher than the percentage of the site of the foot of the mountain. These results can be explained by the fact as follow, when the water erosion occurs, the fine soil particles become suspended in the accumulated water and transported down the slope. While the coarse particles remain at the top of the slope. On the other hand, climate plays an important role, especially with its relationship with the geological aspect of the region. It is known that the topography plays an important role in controlling some processes which related to the soil. Especially, the washing process by controlling the movement of water on the soil surface and its direction (Li et al. 2008). Therefore, the amount of rain that the soil receives represents as an important factor in
relation to the geomorphology of the soil because it can largely control some soil formation processes. This in turn strongly affects the soil development (Al-Hinnawi and Habib, 2012).

These results are in agreement with several studies such as (Fatma & Celenk, 2015; Lili et al, 2008) which showed the speed and direction of the wind and its effect in the transfer and redistribution of the soil separations.

The results of the current study which presented in Table (1) indicate the lowest conductivity value is (EC dS / m 0.13) in the first station (the valley). This decrease in electrical conductivity values is due to the depletion of some salts which are considered as nutrients by the wild plants and forest trees. As well as the work of plant roots in order to penetrate and disintegrate the soil which increases its porosity and the size of the pores with easy movement of water in it, as it is a loam soil. In addition to the precipitation, it works to wash away the accumulated salts and keep them away. Thus, it reduce the electrical conductivity values of the soil (Al-Zubaidi, 1989). Accordingly, this shows the great and effective role of wild plant and the tree species in reducing the electrical conductivity values. As well as adding the organic matter to a soil while improving the soil physical properties (Taddese & Abegaz, 2003). The highest value recorded (EC dS / m 2.86) at the second station (cultivated land) in the summer season may be due to the action of dissolved salts which are added through the defoliation and decomposition of the plant leaves. The results of the study show an agreement with thus that mentioned by (Hailemariam et al., 2010). The reason may be due to a rise in the capillary water with increased evaporation and higher temperatures which causing the accumulation of the salts in the surface (Al-Mousawi, 2007). The salinity limits the viability of agricultural lands due to the fact that it affects its natural properties (Marc, 1983). However, Hofman & Maas (1977) indicated that the wheat crop is an intermediate salt tolerant crop. The results of the statistical analysis according to the Duncan test which were presented in Table (4) showed that there are a time differences between the values of electrical conductivity at a significant level (p≤0.05), but there are no significant spatial differences according to the Duncan test. In Table (5), the results of the current study did not agree with the results of (Mohsen et al., 2019). Where the results of his research are (1.1-20.1). His study was on soils which collected around the cement factory on the western side of the coast of Saudi Arabia. While it was higher than the results of the researcher (Martinez et al., 2019) as his results were recorded (0.01-0.10). His study was assessing the pollutants in agricultural soils in Colombia. For pH values, the lowest value was recorded at 7.21 in the soil of the first station (high mountain), and the highest value was recorded at 7.97 in the first station (the valley) which indicates the alkaline nature for the soil. According to Table (2), the results indicate that the soil is moderately acidic at the site (the foot of the mountain), while there are an increase in the alkalinity of the soil at a bottom of mountain depression (the valley). The reason for the decreasing in a degree of reaction is due to the secretions of roots of evergreen linden trees and the wild plants of acids. Also, the increase in the content of organic matter as well as the release of gas, CO2 which resulting from the decomposition of organic matter that works in order to increase the formation of carbonic acid works to reduce the degree of reaction. These results are agreements with (Smal & OlsZWska, 2008). The high degree of reaction is due to the geology of the area that the rich in carbon rocks (Abdel-Hafiz, 2017) which causes an increase of calcium carbonate due to the washing operations when it rain falls and its direction to the site (the valley) from the first station leading to the hydrolysis of carbonates (Salman et al., 2019). The results of our current study did not agree with the
researchers of (Martinez et al., 2019) whose results were (6.4-7.2). It also did not agree with the results of (Devatha et al., 2018) as his results were (6.54-7.68). His research project was to study the physical and chemical properties of the soils contaminated with petroleum pollutants and it converged with the researcher's results of (Samad et al., 2020). Whereas, the results of his research were (6.43-7.90) which studied the oil contaminated soils and compared it with non-polluted soils. The results of the statistical analysis with the Duncan test which presented in Table (4) showed that there were no time differences between the pH values at a significant level (p≤0.05). There are also no significant spatial differences according to Duncan test in Table (5). Organic matter recorded the lowest value (0.313 g / kg) in the third station (modern desert) and highest value (10.89 g / kg) in the first station (the valley) in which Crataegus trees and wild weeds abound. The decrease in the organic matter in desert areas may be due to the prevailing climatic conditions in the region which characterize by the scarcity of vegetation cover that causes a weak chemical weathering and the prevalence of physical weathering as they collectively work on weak soil composition (Hebel et al. 2015). As well as the low soil content of organic matter due to the lack of sources of organic matter and the speed of its mineralization, we notice a highest value in the first station (the valley). Generally, this station and the valley soil in particular is characterized by its rich and fertile nature. The fallen leaves and roots of dead plants have a great role in increasing the organic matter in the soil as it quickly decomposes and becomes part of the soil humus which remains in the soil for a long time and is the active part of the soil, or the reason may be attributed to the presence of the plants and their remains on the surface with exposure to radiation of the sun and its biological decomposition with the decay of the plant roots causes the accumulation of organic matter in the surface far from the depths. In addition to its effect on other physical characteristics in the soil such as increasing its ability to retain water, it also maintains the soil temperature and a large degree determines the ketionic exchange capacity (Al-Darraji, 2010). The difference in the nature of the environments between the first and third stations with a high temperatures in the summer and low in the winter season to the low values of organic matter compared to the winter and spring seasons and also between the summer season. The reason is that the high temperature in the summer leads to an increase in the decomposition of the organic matter as well as its oxidation and decomposition into the materials which are not useful for plants. While the decreasing of temperature in the winter and spring leads to the oxidation process of organic matter in the soil (Malak and Abdul-Redha, 2011). The results of our study are not agree with the study of the researchers of (Abbas and Al-Jabouri, 2018). The results of their research recorded were (0.8-4.1) g / kg which performed on the soils that close to Euphrates plants for chemical materials and dam cement in Babil governorate. It also disagreed with the results of researcher (Nashmeel et al., 2018) which the results of their research were (2.77-48.20) on a soil close to the iron plant in Erbil. As indicated by the results of the statistical analysis under the Duncan test as in Table (4), there are no temporal differences between the values of organic matter at the significant level (p≤0.05). While there are a significant spatial differences according to the Duncan test in Table (5).

The values of the total minerals of calcium carbonate ranged between the lowest value (164.16 g / kg) at the first station (C) and the highest value (390.10 g / kg) at the third station (Haditha desert). The reason for the high values of calcium carbonate may be attributed to the fact that the nature of a resource material for soils in the study area is rich with the carbonate minerals, especially CaCO3 which also due mainly to the geological formations of this area.
that deposited in the form of the minerals (Al-Khafaji, 2016). The decreasing in the total carbonate values in the first station (the valley) can be explained by the presence of high respiration rates in soils characterized by plants with an increased production of chelates such as organic acids under the trees and other plants that cause the dissolution of carbonates and prevent them from sedimentation (Schlesinger, 1997). In addition, differences in evaporation and transpiration rates between types of plants may play the role in regulating carbonate aggregation. As this reflected in the difference in their content in the soil under different types of plants. Calcium carbonate content is affected by some of the topographical characteristics of the soil such as the texture, slope, and the area down the slope of the mountain by affecting the hydrological conditions of the stations which resulting in different moisture conditions of the soil. Hence, different levels of carbonate leaching are arise (Seibert et al., 2007). Also, calcium carbonate CaCO3 present in the soil is related to the climate, especially the amount of precipitation that penetrates into the bottom of the soil known as the amount of leaching. In humid areas, the amount of washing or falling rain is high which removes the ions that form calcium carbonate and lead to its lack of concentration in the soil solution and its dissolution. In desert areas, the yearly average precipitation is less and this accompanied by the high rate of evaporation. Therefore, calcium carbonate precipitates in the soil.

Table (1) shows that the lowest value of the cation exchange capacitance is 3.03 centimol+Kg-1 in the third station (Haditha desert) and the highest value is 25.82 centimol+Kg-1 at the first station (the foot of mountain). This shows that the lowest value of the cation exchange capacitance is in the sandy soils and the highest value which recorded at the foot of the mountain is due to the tissue of clay soil, Table (3). We can conclude that the soil CEC is mainly stable through the amount of clay and organic matter. Also, It contribute to these properties in producing the negative charge and ion exchange phenomenon referred to in the previous studies and also it increase the accumulation and sedimentation of materials at the foot of the mountain site (Sahar et al., 2020). Cation exchange capacity (CEC) and total exchangeable cations are essential in agriculture and soils in order to estimate the physical and chemical state of the soil. CEC for the soil is a measure of the amount of negative charged sites on the surfaces of soil particles that can retain the positive charged ions (cations) via the electrostatic forces (Dorota & Dawid, 2014). Peinemann et al., 2000 show that the values of the excitation capacitance are greatly influenced by the soil content of sand separations. Therefore, the relationship between them is inverse, as the values of the excitation capacitance of the positive ions decrease when the proportions of sand separations increase in the soil. The minerals of clay and humus are the active medium of the excitation because that the surfaces of these materials carry the negative charge which prepared in order to attract the positive charges in the soil solution. This is shown by the results in Table (1) and (3). These results did not agree with the results of the researchers of (Salem and Al-Waleed, 2019) who found the results of (1.83 - 5.38) centimol+Kg-1. The results of the statistical analysis according to the Duncan test as in Table (4) shows that there are no time differences between the values of cation exchange capacity (CEC) at the significant level (p≤0.05). While there are a significant spatial differences according to the Duncan test in Table (5). Table (1) shows that the values of the exchanged positive ions (Calcium Ca+2, Magnesium Mg+2, Potassium K+2 and Sodium Na+) are (0.10-8.43 centimol/kg), (0.0156-1.00 centimol/kg), (0.042 -3.79 centimol/kgm and (0.044 -1.931 centimol/kg) respectively at the stations of [the second station (cultivated land), the second station (uncultivated land)], [the third station
(Haditha desert), the first station (the valley) ), [The third station (Haditha desert), the second station (uncultivated land)], [the third station (Haditha desert), the first station (the valley)] respectively. We notice that the lowest value was in the sandy soils and the highest one in sandy-clay soils. The reason may be in the mineral composition which represent as a one of the most important characteristics that affect the chemical and physical properties of the soil, and this was indicated by (Almeida et al., 2000). Soils with high content of clay minerals have high exchange capacity and efficiency. Pennll in 2016 asserted that the surfaces of soil particles play an important role in most of the physical, chemical and biological processes and taking place in them. More soils contain higher amounts of clay, and the greater their area results in more bound to the organic matter. There is a positive correlation for the exchange capacity of the cationic ions and the specific surface area (Jindaluang et al., 2010; Johnson, 2002). The results of the statistical analysis under the Duncan test as in Table (4) showed that the existence of time differences between the values of Ca+2 which exchanged the calcium at a significant level (p≤0.05). While there are no significant spatial differences according to the Duncan test in Table (5). There are also no temporal considerable differences at a significant level (p≤0.05) according to Duncan test for the reciprocal Mg+2, reciprocal K+1, reciprocal Na+1, but indicates a presence of significant spatial differences between the soil sites for the same factors at a significant level (p≤0.05).

The results of the dissolved ions cationic ranged as follows: (Calcium Ca+2, Magnesium Mg+2, Sodium Na+, Soluble Potassium K+) are (0.03-3.61 centimol/L), (0.014-1.821 centimol/L), (0.014-0.671 centimol/L), (0.016-0.555 centimol/L)] respectively. The dissolved calcium and magnesium stations were [the third station (Haditha Desert - the second station (uncultivated land)], the dissolved sodium [the third station (Haditha desert) - the second station (cultivated land)] while the dissolved potassium (the third station (Haditha desert) - the station The first (thy valley)].

The results of the dissolved positive ions indicate the highest values in these soils. The reason may be due to the effect of a prevailing climatic conditions in first and second stations as it located in the cold-temperate weather. It also may be attributed to the nature of the soil from the topographic side and to the soil tissue which is mixture - clay as mentioned by (Habib, 2008) that affects the hydrological properties of the soil. The rain water contains dissolved and suspended particles that lead to the washing of salts and components in the upper area and their accumulation in the clay soils. The results of the statistical analysis according to the Duncan test as in Table (4) showed that the existence of the time differences between the values of Ca+2 dissolved calcium, K+1 dissolved potassium, Na+1 dissolved sodium at a significant level of (p≤0.05). While there are no significant temporal differences for the factor Mg + 2 dissolved magnesium at the significant level of (p≤0.05). Spatial differences were found between the values of Ca+2 dissolved calcium, K+1 dissolved potassium, Mg+2 dissolved magnesium, Na+1 dissolved sodium at the significant level of (p≤0.05). The lowest value of dissolved bicarbonate HCO3- (A) was recorded in 0.09 centimol/L in the third station and the highest value was 1.65 centimol/L in the second station (A). The statistical analysis according to the Duncan test as in Table (4) shows that there are no time differences between the values of dissolved bicarbonate HCO3- at a significant level of (p≤0.05). On the other hand, there are significant spatial differences according to the Duncan test in Table (5). While the lowest value of dissolved chloride Cl-1 was 0.05 centimol/L in the third station (A). The highest value was 0.76 centimol/L at the second station (B). Due to the presence of negative charge on the surface of mineral and organic soil colloids, these minerals have the
ability in order to attract the positive ions to their surfaces when they are present in the solution. Therefore, the number of positive ions will increase near the surface and it decreases as we move away from the surface. As for the distribution of negative ions, it decreases on the surface of the particle, and their number will increase as we move away from the surface, also the sum of the positive ions is equivalent to the sum of the negative ions which resulting from the particles. These ions can move easily in the solution due to the lack of attraction between the positive ions and colloidal particles. The negative and positive ions that are movable are called soluble ions to distinguish it from the exchangeable ions. It is possible to dispense of the dissolved ions in the soil when the water passes through it and the soil dries up. The dissolved ions will combine with the dissolved negative ions in order to precipitate in the form of salts, so that they negatively affect the properties of the soil and the growth of the plant. Thus, the soil is called the saline. Therefore, the presence of negative and positive ions in clay soils is large compared to their presence in the sandy soils. This is confirmed by the statistical analysis according to the Duncan test in Table (4) to the presence of the temporal and spatial differences between the values of dissolved chlorine Cl⁻.

**Table (1) Range and average of studied physical chemical factors**

| Stations                | Sulaimaniyah near Bazian factory | Kirkuk near North gas company | Al-Anbar-Hadithah desert |
|-------------------------|----------------------------------|-------------------------------|--------------------------|
| Factors                | Mountai n top                    | Mount ainsid e                | Valley                   | C | Cultivated | uncultivated | Kirk uk contr ol | Hadithah desert | C |
| EC (µs/cm)              | Range                            | Average                       |                           | 2.18-0.73 | -0.19 | 1.52 | -0.13 | 1.95 | -0.45 | 1.15 | -0.54 | 2.86 | -0.35 | 1.65 | -0.22 | 1.93 | -0.18 | 0.69 | 0.2 | -0 | 0.8 | 3 |
| pH                      | Range                            | Average                       |                           | 7.82-7.55 | -7.21 | 7.57 | -7.24 | 7.97 | -7 | 7.57 | -7.43 | 7.58 | -7.23 | 7.57 | -6.91 | 7.3 | -7.26 | 7.63 | 7.0 | -0 | 7.6 | 8 |
| Organic matter         | Range                            | Average                       |                           | 8.22-3.64 | -3.01 | 10.31 | -2.98 | 10.8 | 9 | -3.13 | 4.34 | -3.11 | 6.80 | -1.27 | 4.17 | -1.66 | 5.62 | -0.31 | 0.42 | 0.4 | -1 | 0.5 | 0 |
| Total CaCO₃            | Range                            | Average                       |                           | 352.33-259.03 | 189.0 | 0-288.3 | 164.166-268.46 | 193 | 200-273.100 | 215.26 | 6-290.16 | 225.566 | -281.866 | 221.800-342.3 | 275.300 | -390.100 | 26 | 9.0 | 0.0-36 | 3.7 |
| Parameter     | Range     | Average   |
|---------------|-----------|-----------|
| CEC           | 24.28-19.22 | 21.147 |
| Mutal Ca<sup>2+</sup> | 4.24-0.13 | 2.108 |
| Mutal Mg<sup>2+</sup> | 1.07-0.07 | 0.489 |
| Mutal K<sup>+1</sup> | 0.51-0.08 | 0.318 |
| Mutal Na<sup>+1</sup> | 0.39-0.07 | 0.267 |
| Dissolv Ca<sup>2+</sup> | 0.63-0.13 | 0.321 |
| Dissolv Mg<sup>2+</sup> | 0.17-0.11 | 0.156 |
| Dissolv Na<sup>+1</sup> | 0.27-0.02 | 0.185 |
| Dissolv K<sup>+1</sup> | 0.27-0.04 | 0.182 |
Different letters indicate that there are significant differences in the Duncan test, while similar letters mean that there are no significant differences.

Table No. (2) Classification of soil quality according to the pH indicator (Al-Hadithi & Al-Zaidi, 2019)

| pH of soil | Soil class       |
|------------|------------------|
| Less than 4.5 | Extremely acidic |
| 4.5-5     | Very high acidic |
| 5.1-5.5   | High acidic      |
| 5.6-6     | Acidic           |
| 6.1-7.3   | Less acidic      |
| 7.4-7.8   | Less alkaline    |
| More than 7.8 | Alkaline        |

Table (3) shows soil texture values

| Region                          | Soil division | Sand | Silt | Clay | Texture type     |
|---------------------------------|---------------|------|------|------|------------------|
| Sulaimaniyah near Bazian factory | Mountainside  | 534  | 384  | 84   | sandy loam       |
|                                 | Mountain top  | 492  | 364  | 144  | loam             |
|                                 | Valley        | 492  | 384  | 124  | loam             |
|                                 | Control       | 552  | 344  | 104  | sandy loam       |
| Kirkuk near North gas company   | Cultivated    | 512  | 384  | 104  | loam             |
|                                 | Uncultivated  | 652  | 244  | 104  | sandy loam       |
|                                 | Control       | 592  | 304  | 104  | sandy loam       |
| Al-Anbar-Hadithah desert        | Hadithah desert | 840  | 90   | 70   | sandy loam       |
|                                 | Control       | 853  | 84   | 63   | sandy loam       |
### Table(4) Dunkin test for multiple averages for studied factors during four seasons (2019-2010).

| Seasons | Factors           | Spring | Summer | Autumn | Winter |
|---------|-------------------|--------|--------|--------|--------|
|         | EC (µs/cm)        | 0.762a | 1.569b | 1.258b | 0.336a |
|         | pH                | 7.514a | 7.427a | 7.516a | 7.275a |
|         | Organic matter    | 6.666a | 3.792a | 3.207a | 2.517a |
|         | Total CaCO$_3$    | 10.32a | 16.54b | 13.98a | 8.08a  |
|         | CEC               | 23.438a| 15.145a| 16.374a| 17.541a|
|         | Mutual Ca$^{2+}$  | 0.154a | 4.907b | 3.651b | 1.099a |
|         | Mutual Mg$^{2+}$  | 0.074a | 0.113a | 0.417a | 0.139a |
|         | Mutual K$^{+}$    | 0.900a | 1.178a | 0.811a | 0.250a |
|         | Mutual Na$^{+}$   | 0.233a | 0.457a | 0.450a | 0.221a |
|         | Dissolved Ca$^{2+}$| 0.453a | 1.350b | 0.711ab| 0.265a |
|         | Dissolved Mg$^{2+}$| 0.163a | 0.449a | 0.348a | 0.12a  |
|         | Dissolved K$^{+}$ | 0.348a | 0.110b | 0.142ab| 0.135ab|
|         | Dissolved Na$^{+}$| 0.052b | 0.178a | 0.138ab| 0.068ab|
|         | Dissolved HCO$_3^-$| 0.289a | 0.224a | 0.645a | 0.401a |
|         | Dissolved Cl$^{-}$| 0.331a | 0.471b | 0.315ab| 0.324ab|

Similar letters mean that there are no significant differences according to the factors studied at the level of significance P≤0.05.
Table (5) Duncan’s test of the studied factors depending on the stations studied during the study period (2019-2020).

| Station | Factors                  | Sulaimaniyah near Bazian factory | Kirkuk company near North gas company | Al-Anbar-Hadithah desert |
|---------|--------------------------|----------------------------------|---------------------------------------|--------------------------|
|         | Mounta in top Mountains ide Valley C Cultivated Uncultivated Kirkuk control Hadithah desert Control |
| E C (μs/cm ) | 1.202a 0.94a 1.120a 0.869a 1.449a 1.019a 1.050a 0.564a 0.507a |
| pH      | 7.685a 7.432a 7.672a 7.342a 7.495a 7.395a 7.092a 7.413a 7.293a |
| Organic matter | 5.967cd 6.885d 5.879cd 3.692bc 4.422bcd 2.617ab 2.992bc 0.379a 0.45a |
| Total CaCO₃ | 43.10cd 32.25d 39.87cd 29.74bc 23.95bc 22.98cd 21.75bc 49.37cd 47.76cd |
| CEC     | 21.147c 20.596c 16.539b 21.827c 22.217c 22.440c 22.307c 3.617a 2.16a |
| Mutual Ca⁺² | 2.108a 3.704a 4.068a 1.906a 3.764a 3.752a 2.002a 0.485a 0.445a |
| Mutual Mg⁺² | 0.489b 0.371ab 0.331ab 0.104ab 0.123ab 0.096ab 0.092ab 0.021a 0.021a |
| Mutual K⁺¹ | 0.318a 0.367a 1.631b 0.443a 2.65c 0.320a 0.461a 0.263a 0.305a |
| Mutual Na⁺¹ | 0.267a 0.313a 0.882b 0.473ab 0.423a 0.136a 0.283a 0.122a 0.107a |
| Dissolv ed Ca⁺² | 0.321a 0.357a 1.017ab 0.739ab 1.231ab 1.595b 0.429ab 0.220a 0.229a |
| Dissolv ed Mg⁺² | 0.156a 0.165a 0.298a 0.417a 0.301a 0.866b 0.103a 0.026a 0.029a |
| Dissolv ed K⁺¹ | 0.185ab 0.184ab 0.182b 0.182ab 0.298ab 0.302ab 0.125ab 0.015a 0.015a |
| Dissolv ed Na⁺¹ | 0.116ab 0.148ab 0.235ab 0.067ab 0.203b 0.07b 0.069ab 0.027a 0.036a |
| Dissolv ed HCO₃⁻ | 0.306abc 0.216ab 0.273ab 0.580abc 0.875c 0.738bc 0.219abc 0.117a 0.091a |
| Dissolv ed Cl⁻ | 0.489b 0.302b 0.402b 0.336b 0.527b 0.375b 0.459b 0.133a 0.114a |

Different letters indicate that there are significant differences in the Duncan test, while similar letters mean that there are no significant differences.

4. References

[1] Abdel-Hafiz MA (2017). Hydrochemical and environmental assessment of waterlogging and soil for different purposes at El Obour city, East Cairo, Egypt. MSc. Thesis, Geol dep., Fac Sci, Al-Azhar Univ, Assiut, vol 273. https://doi.org/10.13140/RG.2.2.12793.67687.
[2] Almeida, J.A., K.C. Maçaneiro, and E. Klamt. 2000. Mineralogia da fração argila de solos vermelhos com horizontes superficies brunados do Planalto de Lages (SC). Rev Bras Cienc Solo. 24:815-828.

[3] Al-Darraji, Saad Ajeel Mubarak, 2010. The effect of nitrogen and phosphorus quantities on the yield, its components, qualities and some field characteristics of sunflower crop, Master Thesis (unpublished) submitted to the College of Agriculture, University of Baghdad 1983.

[4] AL-Anbari, Riyad H. Mohammed M. AL-kaissi. Mohammed A. Al-Ameri. 2013. Distribution of some Heavy Metals Pollution Caused by Al- Daura Refinery in the Surrounding Region. Eng.& Tech. Journal, Vol 31.Part (A), No.20.

[5] Al-Hadithi, Karami Abdul-Ghafoor Ali and Al-Zaidi, Nashwan Mahmoud Jasim 2019. The variation in urban space pollution in the city of Mosul with heavy metals and methods of their sustainability, Anbar University Journal of Human Sciences, Issue (2) (June) 2019.

[6] Al-Khafaji, Ali Khalil Abd al-Kazim Badi , 2016. Detecting the pollution status of the soils and waters of the Lake Sawa region using remote sensing techniques. Master Thesis in Agricultural Sciences, Department of Plant Production / Soil and Water Resources.

[7] Al-Hinnawi, Sami and Habib, Hassan, 2012. The effect of spatial change on the morphological and chemical properties of some soils of the western foot of Jabal Al-Arab. Damascus University Journal of Agricultural Sciences - (2012) Volume (28) - Issue 2 - Pages: 435-454.

[8] Al-Zubaidi, Ahmed Haider, 1989. Soil salinity - theoretical and applied foundations. faculty of Agriculture. University of Baghdad - Ministry of Higher Education and Scientific Research - Iraq.

[9] Awadh, S. Muhammad. 2013. Assessment of the potential pollution of cadmium, nickel and lead in the road-side dust in the Karkh district of Baghdad City and along the highway between Ramadi and Rutba, West of Merit Research Journal of Environmental Science Iraq. Toxicology. Vol.1(7)pp.126-135. http://www.meritresearchjournals.org/est/index.htm.

[10] Al-Mousawi, Kawthar Aziz Hamid , 2007. The effect of alternating irrigation water quality and soil moisture content on some physical and chemical properties of marsh Al Hammar soil and water consumption of sorghum crop. PhD, College of Agriculture - Basra University - Iraq.

[11] Abbas, Ahmed Karim and Al-Jubouri, Hamed Hussein Rajab, 2018. Evaluation of the standards of lead, nickel and cadmium pollution caused by industrial wastes of Al Furat chemical and cement plants in agricultural soils in Babil Governorate. Iraqi Journal of Soil Sciences, Volume (18) - Issue (1) - 2018.

[12] Amin, Omid Nuri Muhammad, 2003. Foundations of agricultural crops in the Demi region, Sulaymaniyyah University.

[13] Balamurugan J.; Kumaraswamy K.; Rajuarajan A., 2000: Effects of Eucalyptus citriodora on the physical and chemical properties of soils. Journal of the Indian Society of Soil Science 48(3): 491- 495.

[14] Çelenk F., and Fatma Kızıloğlu, T. 2015. Distribution of Lead Accumulation in Roadside Soils: A Case Study from D 100 Highway in Sakarya, Turkey. International Journal of Research in Agriculture and Forestry Volume 2, Issue 5, PP 1-10.
[15] Dawid J.*, & Dorota K., 2014. A COMPARISON OF METHODS FOR THE DETERMINATION OF CATION EXCHANGE CAPACITY OF SOILS. ECOL CHEM ENG S. 2014;21(3):487-498.

[16] Devatha C. P. Vishnu (2019). Investigation of physical and chemical characteristics on soil due to crude oil contamination and its remediation.

[17] Gharaybeh, K. M. 2010. Environmental pollution concept, forms and how to reduce the severity of it. Journal of Environmental Studies. Volume 3: 121-133.

[18] Hailemariam, K. Kindeya, G. and Charles, Y., 2010. Balanites aegyptiaca, a potential tree for parkland agroforestry systems with sorghum in Northern Ethiopia. J. Soil Sci. Environ. Manage. 1(6): 107-114.

[19] Habeel, Ahmed and Abdel Qader, Kamal Abdel Salam and Al-Dhafri, Attia Ibrahim, 2015. The effect of calcium carbonate on the bulk density of some limestone Libyan soils in Al-Jabal Al-Akhdar region. Al-Mukhtar Journal of Science, Vol. (30), (01), year (2015) 40-50 Omar Al-Mukhtar University, Al-Bayda, Libya. Deposit number Dar Al-Kutub: / 280 2013 Benghazi.

[20] Jackson, M. L. 1958. Soil chemical analysis. Prentice hall Inc. Englewood. Ciffs. N. 11: 188-196.

[21] Jindaluang, W., I. Kheoruenromne, A. Sudhiprakarn, B. Pal Singh, and B. Singh. 2010. Relationships between mineralogical properties and carbon and nitrogen retention in upland soils of Thailand. 19th World Congress of Soil Science, Soil Solutions for a Changing World. p.92-95

[22] Johnson, C.E. 2002. Cation exchange properties of acid forest soils of the north eastern USA. European Journal of Soil Science. 53:271-282.

[23] Joudah, R. Aziz. 2013. Heavy metals pollution in the roadside soil of Bab Al-Muadham city centre/Baghdad. Aust. J. Basic & Appl. Sci., 7(12), p:35-43.

[24] Khan, A. & Ghouri, A. (2011). Environmental pollution: its effects on life and its remedies. Journal of Arts, Science and Commerce; 2: 276-285.

[25] Khan, F., Z. Hayat, W. Ahmad, M. Ramzan, Z. Shah, M. Sharif, I. A. Mian and M. Hanif, 2013. Effect of slope position on physicochemical properties of eroded soil. Soil Environ. 32(1): 22-28.

[26] Laurent, F., Cébron A., Schwartz, C., & Leyval, C. (2012). Oxidation of a PAH polluted soil using modified Fenton reaction in unsaturated condition affects biological and physico-chemical properties. Chemosphere, 86(6), 659-664.

[27] Lili Lang, Wang, X., Wang, G., Hua, T., and Wang, H. 2015. Effects of aeolian processes on nutrient loss from surface soils and their significance for sandy desertification in Mu Us Desert. China: a wind tunnel approach. Journal of Arid Land, 7(4): 421 428.

[28] Maas E. V and Hofman G. J. 1977. Corps salts tolerance current assessment. Irrig. Sci, 10.24.29.

[29] Marc H;1983. Coors de drainage, irrigation et salinité. El harache. Algerie.2. 111.

[30] Martinez –Mera,. E.A.; Torregroza-Espinosa, A.C.; Crissien-Borrero, T.J.; Marrugo-Negrete, J.L. and González-Márquez, L.C. (2019). Evaluation of contaminants in agricultural soils in an Irrigation District in Colombia. Heliyon. 2019 Aug; 5(8): e02

[31] Mohsen M. El-Sherbiny, Ali I. Ismail, Mohamed E. El-Hefnawy. 2019. A preliminary assessment of potential ecological risk and soil contamination by heavy metals around a cement factory, western Saudi Arabia. Open Chem., 2019; 17: 671–684.
[32] Megharaj, M., Ramakrishnan, ., Venkateswarlu, K., Sethunathan, N., and Naidu, R. 2012. Bioremediation approaches for organic pollutants: a critical perspective. Environment International, 37(8). 1362-1375.
[33] Mahsoub, Muhammad Sabr and Arab, Muhammad Ibrahim. (2002). Natural hazards and disasters event and confrontation. Arab Thought House. Cairo.
[34] Mashhout, Kazem (1999). Principles of Soil Chemistry, Dar Al-Kutub Publishing House, Al-Maws, p.83.
[35] Nashmeel S.K , Shelan M.K and Idrees N.A.(2018). An Assessment of Heavy Metal Soil Contamination in a Steel Factory and the Surrounding Area in Erbil City.
[36] Page, A.L., R.H. Miller and D.R. Keeney,(1982). Method of soil analysis, Part (2), 2th Argon. Madison, Wisconsin, U.S.A.
[37] Pennell, KD .2016. Specific Surface Area. Earth Systems and Environmental Sciences. http://dx.doi.org/10.1016/B978-0-12-409548-9.09583-X.
[38] Salem, Mansour Oweidat and Al-Walid, Samira Moussa, 2019. Evaluation of some physicochemical properties and concentration of some heavy metals in agricultural soil fertilized with chemical fertilizers during long seasons of the year in Brak Agricultural Project, Libya. Issue of the third annual conference on the theories and applications of basic and biological sciences 7 September 2019.
[39] Sahar, I.M. Alobyde; Firas, S. Hamid and Ibrahim ,K.S. Albayati.(2020). Comparison of Artificial Neural Network and Regression PedotransferFunction for prediction of soil cation exchange capacity at Iraq, Ray ALJazeera, Mosul region. Journal of Engineering Sciences and Information Technology Volume (4), Issue (2): 30 June2020P: 90-109.
[40] Samad Z.; Mahmood V. and Mohammad H.B. (2020). Analysis of the physical and chemical properties of soil contaminated with oil (petroleum) hydrocarbons. Earth Sci. Res. J. vol.24 no.2.
[41] Salam Hussein Ewaid et al 2020 J. Phys.: Conf. Ser. 1664 012143.
[42] Schlesinger, W.H., 1997. Biogeochemistry, 2nd ed. Academic Press, San Diego.
[43] Smal H, Olszewska M. (2008) The effect of afforestation with scots pine (pinus sivestris L.) of sandy post – arable soils on their selected properties. II Reaction, carbon, nitrogen and phosphorus. Plant soil, 303: 171-187.
[44] Mudhafar A. Salim et al 2020 J. Phys.: Conf. Ser. 1664 012105.
[45] Taddese, G. & F. Abegaz, (2003). The nature and properties of salt Affects soils in middle a wash valley of Ethiopia. Addisababa, Ethiopia (Internet).
[46] Z, Li, Liu WZ, Wang QX, 2008. Effects of land use type and slope position on soil physical properties in loess tableland area. Ying Yong Sheng Tai Xue Bao ;19(6):1303-8.
[47] Ahmed Sabah Al-Jasimee et al 2020 J. Phys.: Conf. Ser. 1664 012141.
[48] Ewaid, S.H.; Abed, S.A.; Al-Ansari, N. Assessment of Main Cereal Crop Trade Impacts on Water and Land Security in Iraq. Agronomy 2020, 10, 98.
[49] Zhang, F.; Yan, X.; Zeng, C.; Zhang, M.; Shrestha, S.; Devkota, L.P.; Yao, T. (2012). Influence of traffic activity on heavy metal concentrations of roadside farmland soil in mountainous areas. Int. J. Environ. Res. Public Health, 9, 1715–1731.