IRAQI Academic Scientific Journals

Samarra Journal of Pure and Applied Science

SJPAS

www.sjpas.com

p ISSN: 2663-7405
e ISSN: 2789-6838

Assessment of Salts and Organic Matter of Umm Qasser Soil, Basrah

Huda A. Daham

Department of Geology, College of Science, University of Basrah, Basrah, Iraq

https://doi.org/10.54153/sjpas.2022.v4i1.339

Article Information

Received: 19/12/2021
Accepted: 16/01/2022

Keywords:

Sulfate, Gypsum, chloride, salty soil, organic matter

Corresponding Author

Email: huda.daham@uobasrah.edu.iq
Mobile:

Abstract

This study was conducted in Umm Qasser, which is located in Al-Zubair district, in Basra. The research focused on studying the soil content of sulfates, chlorides, and organic matter. The research aims to measure the concentrations of salts and organic matter, compare them with standard specifications, and to know whether these concentrations affect the engineering behavior of the soil or not, and chemical tests were carried out for them. The results show that the average of sulfate is 0.55%, gypsum is 4.75%, chloride is 0.35% and organic matter is 4.28%. The study shows that the soil content of chlorides, organic matter, and Gypsum were within the effective limits on engineering behavior of soil except for other forms of sulfates, and the study shows that the fluctuation of the soil content of salts, and organic matter from one site to another, and at different depths is subject to change with time due to its influence by geological and environmental factors at the study area.

Introduction

In arid regions, salty soil is a typical type of area degradation [1]. The salt accumulation in the soil affects the soil's stability, leading to a decrease in the swelling index, liquid limits, and a rise in the compression index [2] because the salts act as cementing materials between the grains of the soil, but the opposite occurs when the salt is exposed to solubility [3], salty soil cause negative effect on concrete and soil foundation, like sulfates, chlorides, gypsum, and organic matter. The confined compressive strength decreased in concrete subjected to high saline content from 11to 22% [4]. The chemical test is essential to define the percent of salts that cause concrete corrosion, the reinforcing steel, and affect the soil. Therefore, it is necessary to study the factors that affect the building design and implementation aspects to reduce the cost and effort involved. Below is a summary of the important aspects of the process that relates to the chemical properties of the soil.

Sulfate salts are the common salts in the soil, especially sodium, magnesium, and calcium sulfate. Gypsum deposits are the most important sources of sulfates [5]. According to [6] increasing the amount of calcium sulfate in the soil reduces the plasticity index and increases unconfined compressive strength (UCS). The presence of sulfates 5 percent in the soil is safe and do not causes concrete deterioration and structural collapse. [7].

The amount and kind of gypsum present in the soil, the ambient circumstances, and the type of engineering challenge under consideration all influence the gypsum effect. [8]. When dry, it is highly robust and has good characteristics, but as moisture content increases, it gradually weakens. [9]. The storage bulk increased as the gypsum content increased [10]. From an engineering standpoint, gypsiferous soils are noted for rapid seepage of water through soil pores, cavity formation due to gypsum solubility in groundwater that floods or passes through these soils, strength degradation, rising settlements, and compressibility [11]. The effect of gypsum is negligible on the unconfined compressive strength of the improved clay soil by adding only calcium carbonate, while the mineral composition of clay plays an important role in chemical reactions with gypsum [12].

If gypsum has been in close contact to concrete, it affects the concrete used in foundation. The gypsum content in the soil should not exceed 2.5 percent, according to a British standard [13]. Increasing the concentration of chloride salts in the soil modifies its geotechnical qualities, resulting in increased dry density, decreased moisture content, swelling pressure, and plasticity index [14]. Ion chloride has an effect because it can be converted to (HCl), which reacts with the iron in the concrete and causes it to corrode. Since chloride salts are very soluble in water, they have a substantial impact when they enter the hydration process [15] Chloride salts increase the solubility and penetration of sulfate into concrete, while chloride salts increase the compressibility of concrete, according to [16], [17] show that the length of cracks that occur in soda saline-alkali soil has a linear relationship with its chloride and sodium content. The increase NaCl concentration effects facilitated the dissolution of calcite and dolomite, thus causing the loss of calcium cement, which resulted in the soil structure $Ca^{2+,}$ $Mg^{2+,}$ and K^{+} ^{l}eaching, the dissolution of associated minerals, and the dispersion of clay particles have also been promoted by the caution exchange [18].

Organic matter in soil and degree of decomposition affected on geotechnical properties of soil [19]. Increasing the organic content in the soil, increasing the plasticity index resolve shows a greater tendency for the soil to expand and shrinks, which can lead to major adverse effects on buildings built on these types of materials [20]. The presence of organic matter leads to an increase in the percent of void ratio in the soil after the decomposition of those organics, making soil unsuitable for filling [21]. When the percent of organic matter in the soil ranges from 2-3% change of soil strength and compressibility [22].

The research aims to measure the concentrations of salts and organic matter, compare them with standard specifications, and to know whether these concentrations affect the engineering behavior of the soil or not

Study Area Location

The study area is located in the south of Iraq, on the waterway of Khor Al-Zubair, which is a part of Khor Abd Allah, and ultimately leads to the Arabian Gulf, the study area is located between longitude 47˚54'30" to 47˚55'30" East and latitude between 30̊ 1' 0" to 30˚3' 0" North. Fig.1.

Geology of the Study Area

The study area is one of those that has been marked by a scarcity of rocky findings as a result of climate change, it has a low topography and a heavy layer of Quaternary sediment (AL –Saeeb *etal*; 1982)23, The study area is located in the Zubair secondary zone according to longitudinal tectonic divisions, the secondary Zubair zone encompasses the southern portion of the Mesopotamia plain and is the subsurface geological formations, most notably the sandy formations, Al-Luhais and Nahr Omar, continue in a northwest-southeast direction for hundreds of kilometers towards Kuwait and the Arabian Gulf,to the north and north-east, the Takhdad-Qurna fault runs parallel to the secondary Zubair zone[24]. In terms of Iraq's transverse tectonic divisions, the study area lies inside the Basra block Fig. 2, which is defined by the existence of numerous parallel subsurface faults that run northeast to southwest [25].

Along the Iraq-Kuwait border, the NE-SW oriented AL-Batin Lineament is a significant surface feature within Iraq, the impact of this trait is unknown [26].

Materials and Methods

This stage included collecting information about the study area, selecting four boreholes for the sampling and plotting them on the map and given the sequence from 1 to 4 Fig. 1.

Field Work

Drilling three wells in the study area at four sites to determine the percentage of salt in them was part of this stage Fig. 1. Average of one sample per meter, disturbed samples were taken from the soil at a depth of 1-3 meters. The hand auger was used to drill the borehole. The samples were wrapped in nylon bags and transported to a laboratory for testing.

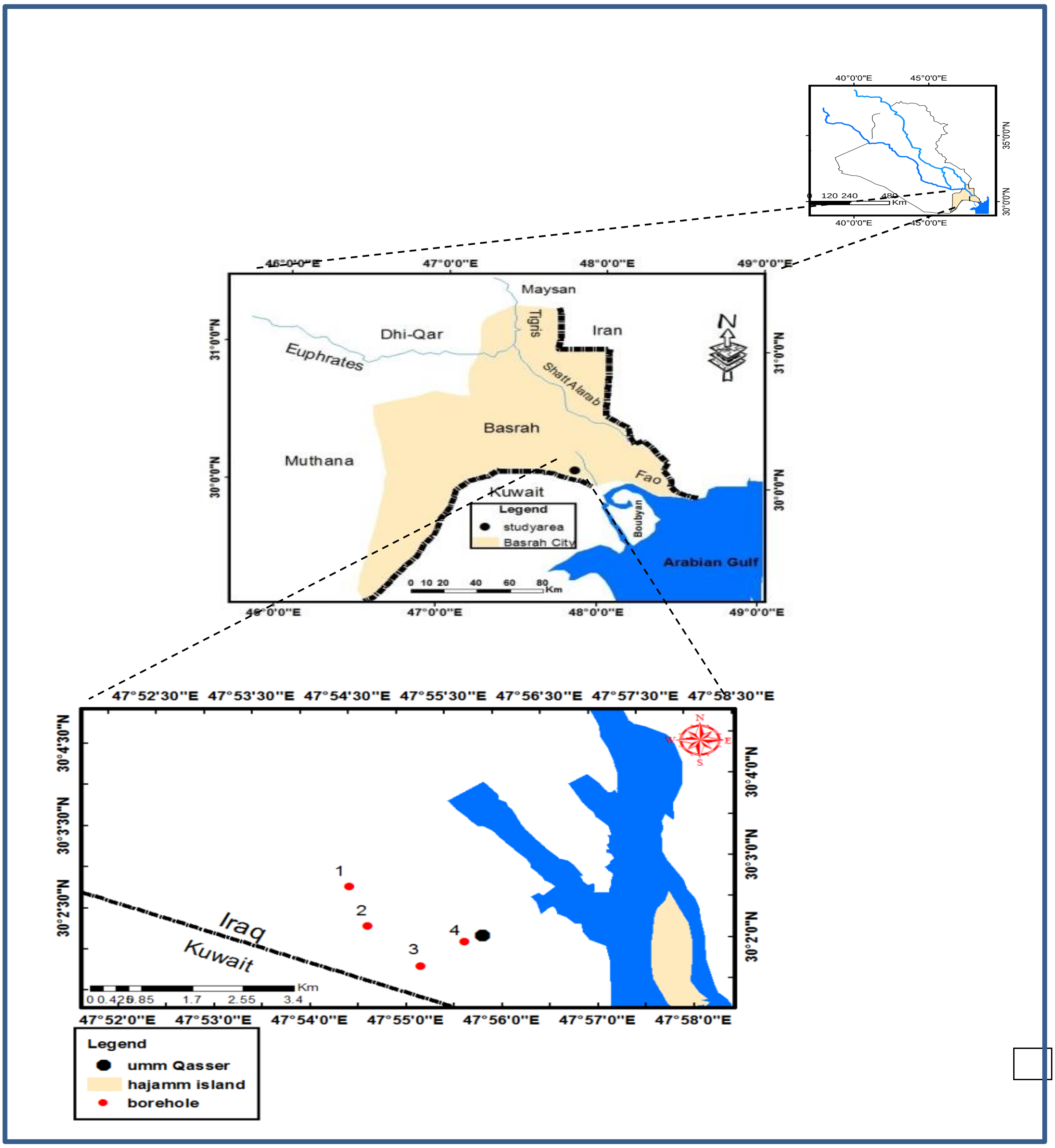

Fig. 1. Map of the study area

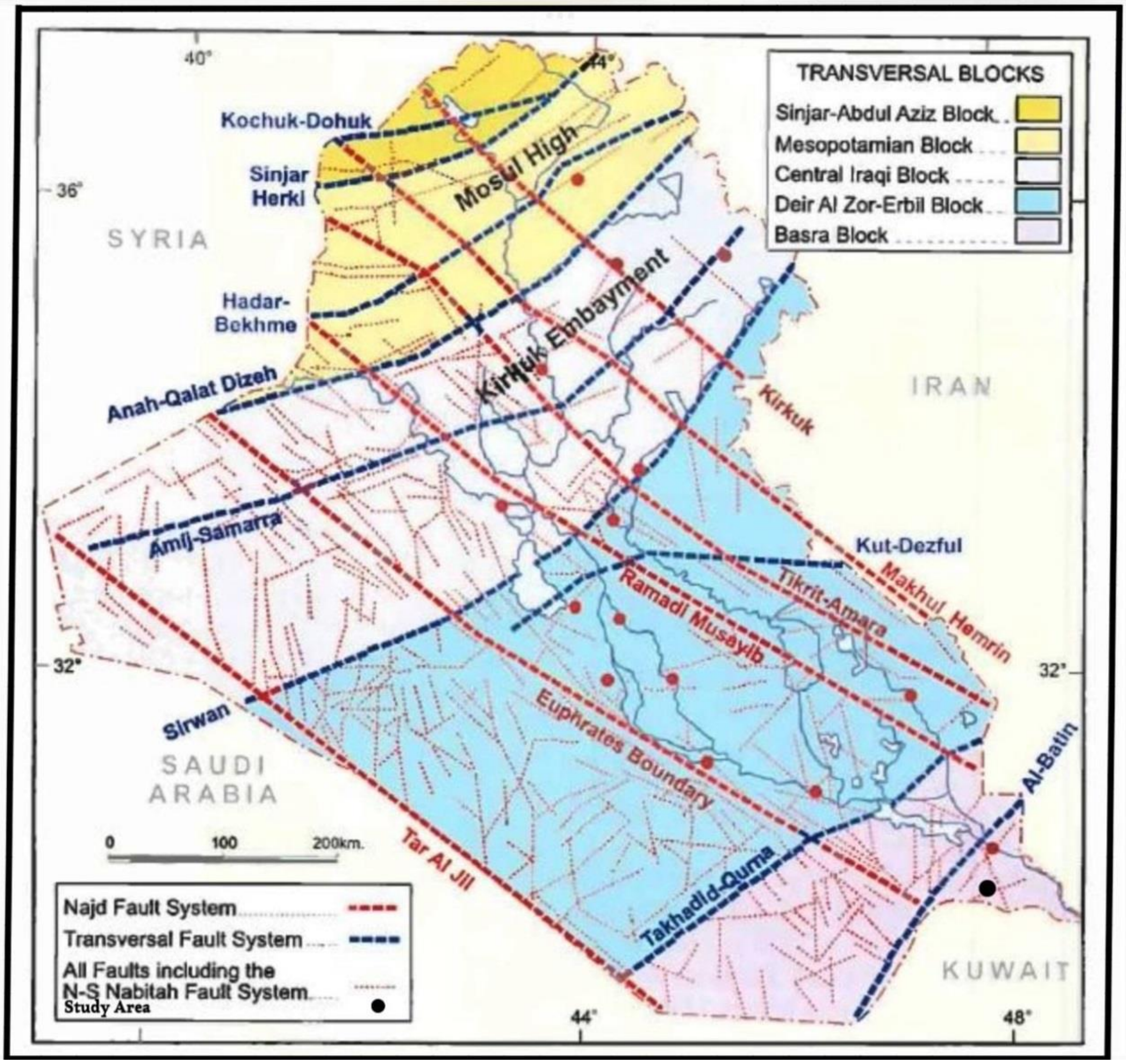

Fig. 2. Iraq's tectonic divisions after [27].

Laboratory Test

At the College of Agriculture, University of Basra, laboratory tests were performed on samples extracted from the study area to determine their chemical properties according to British Standard1733- Part 3:1990, which included measuring the percentage of sulfates, chlorides, gypsum, and organic matters.

Results and Discussion

Sulfate SO_3%

The results show sulfate content ranged between 0.36% at BH3 depth 3 m to 0.95% at BH1 depth 1 m with an average of 0.55 %, as well as results, show sulfate ranged between (0.51-0.95) % with an average of 0.65% at 1 meter, between (0.43-0.60) % with an average 0.5% at 2m and it ranged between (0.36-0.73) % with average 0.54at depth 3m Table 1.

It can be seen from Fig. (3) the sulfate varies with depth increasing and decreasing at BH1, BH2and BH4, but it decreases with depth at BH3. The reason for the difference in the sulfate content because the source of sulfates at Basra is gypsum and anhydrite mixed with recent sediments [28], human activities, irrigation, rainfall, dilution, the effect of tidal water, and it reduces due to the presence of chlorides in high percent can be increased sulfate solubility. In general, the results of sulfates percent in the study area did not surpass the effective value of the engineering behavior of the soil, which is 5%, according to [7].

Table 1: Results of Chemical Test of Soil Study Area

BH.NO.	Depth(m)	SO_3%	Gypsum%	Cl%	O.M%
BH1	1	0.95	6.3	0.32	5.43
	2	0.61	3.83	0.24	5
	3	0.73	5.25	0.12	5.1
BH2	1	0.62	5.4	0.11	3.3
	2	0.44	4.8	0.22	3.1
	3	0.62	5.5	0.13	5.5
BH3	1	0.51	4.2	0.92	4.6
	2	0.43	4.7	0.83	3.8
	3	0.36	3.6	0.86	3.5
BH4	1	0.51	4.12	0.21	3.21
	2	0.52	4.43	0.14	4.32
	3	0.43	4.83	0.11	4.54

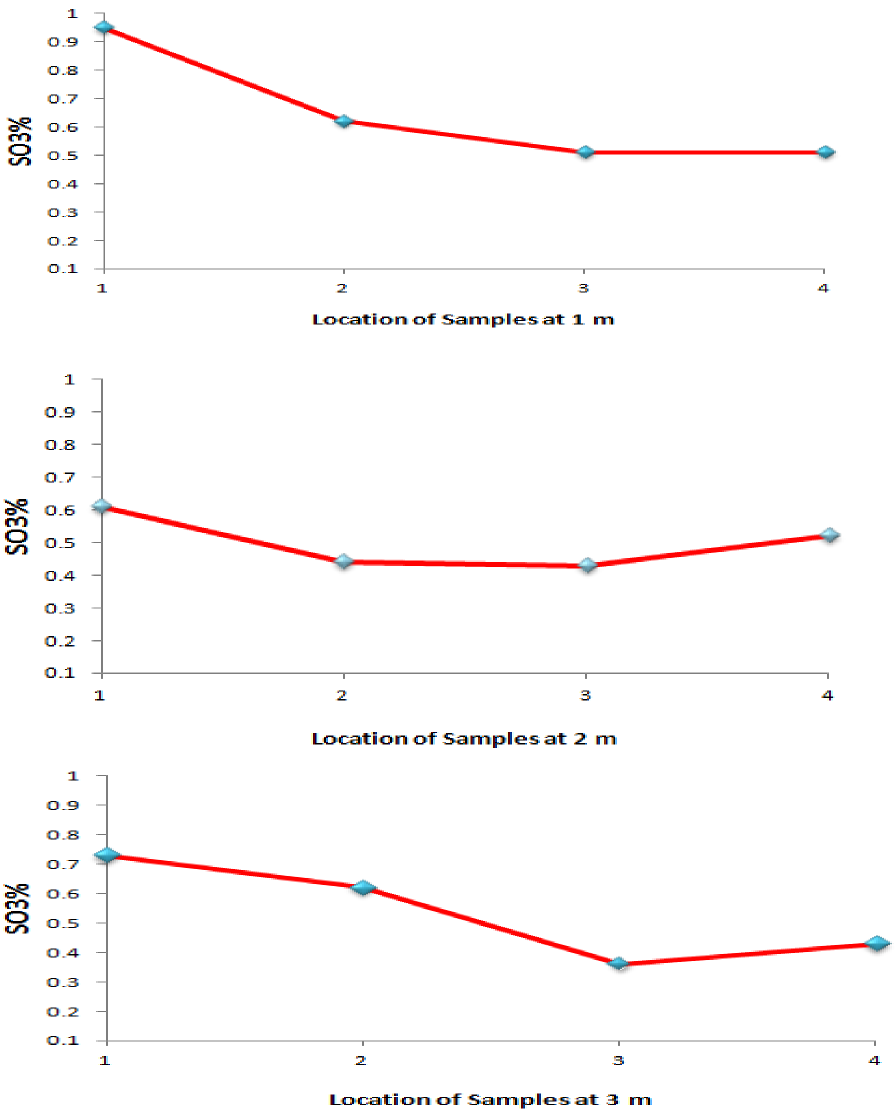

Fig. 3. Distribution of Sulfate in Boreholes of the Study Area

Gypsum Content ($CaSO_4.2H_2O$

The Gypsum values ranged between 3.6% at BH3 depth 3m to 6.3% at BH1 depth1m with an average of 4.45% Table 1. The gypsum values at study area ranged between (4.12-6.3) % at depth 1m with average of 5. %, (3.83-4.8)% at depth 2m with average 4.4 % and it ranged between (3.6-5.5)% with average 4.8% at depth 3m Fig.(4).

Gypsum values in the study area lead to engineering issues with time. According to [13] the gypsum content in the soil should not exceed 2.5 percent. In sandy soils, increasing the gypsum content increases the percentage of void and optimum moisture content while decreasing the dry density [29]. When gypsum is present in dry soils, the behavior of gypsum as a binding element for soil particles results in the formation of a stable structure, which deteriorates (settlements in the soil) as water goes through it and gypsum dissolves, weakening the structure, increased gypsum content increases the ability of soil to collapse [30].

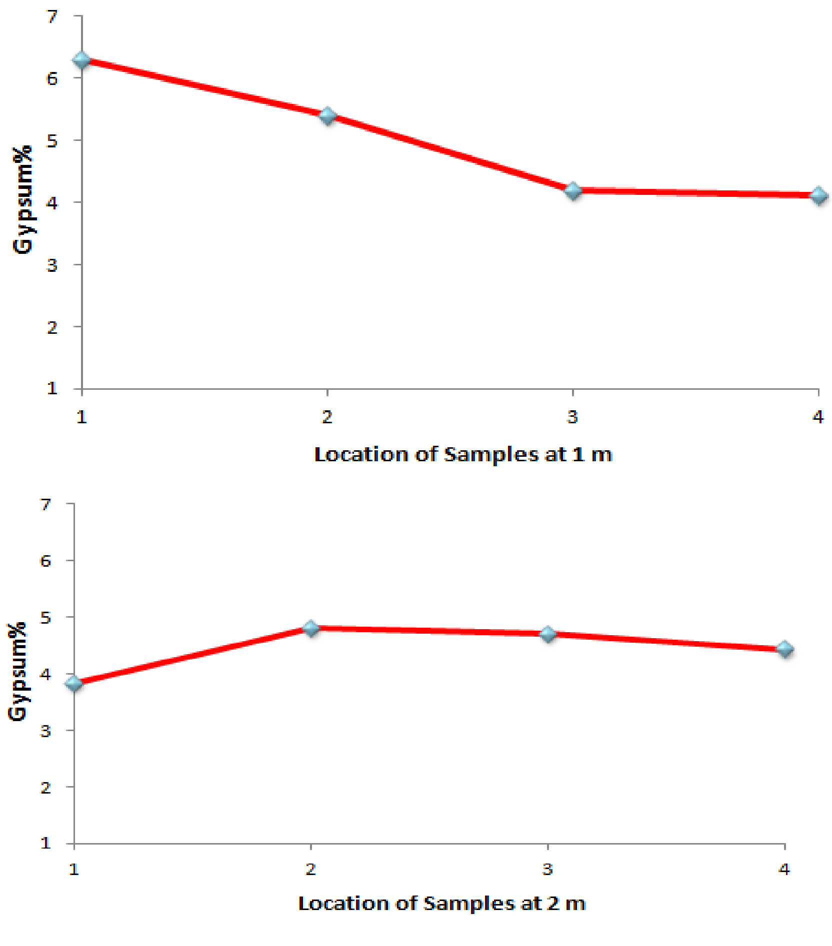

Fig. 4. Distribution of Gypsum in Boreholes of the Study Area

Chloride content $(Cl)^-$

The content of chlorides in the study area ranged between (0.11-0.92) % at BH1 and BH3, with an average of 0.35% Table 1. The results show chloride content ranged between (0.11 - 0.92) % at depth 1m with average 0.39 %, between (0.14-0.83) % with average 0.403% at depth 2m and ranged between (0.11-0.86) % with average 0.305% at depth 3m Table1.

The chloride content at the study area is varied with depth, but decreasing with depth at BH1 Fig. 5, due to high evaporation and dryness. An increase in chlorides causes a drop in Atterberg limits, an increase in dry density, and an effect on concrete's compressive strength, chloride content at the study area may attack the reinforcing steel, foundations and leading to attack with time because the chloride percent exceeded 0.1%.

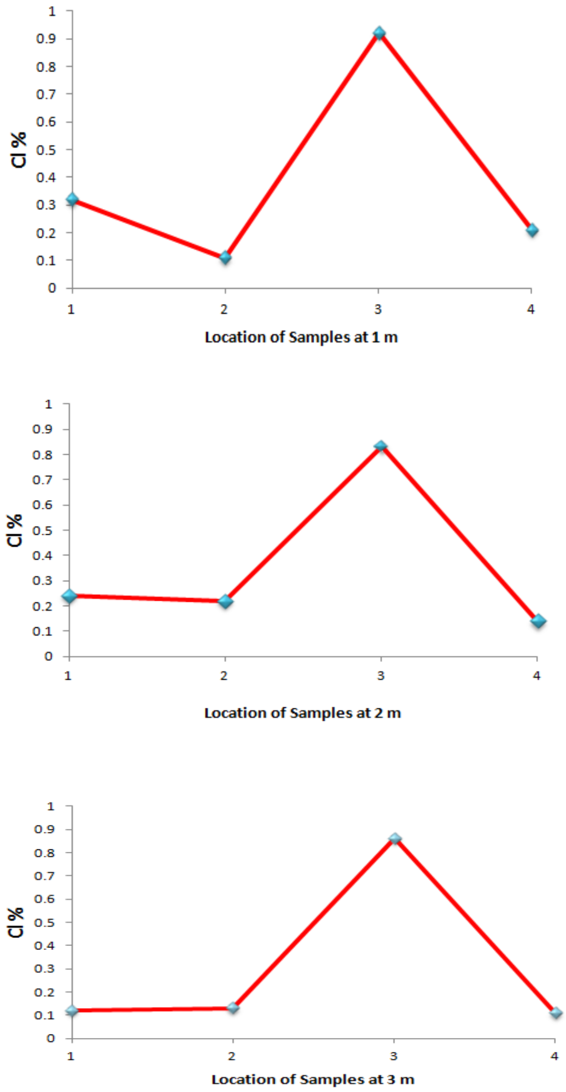

Fig. 5. Distribution of Chloride in Boreholes of the Study Area

Organic Matter Content (O.M)

The maximum percent of organic materials is 5.43% at BH1 depth 1m, the minim value is 3.1% at BH2 depth 2m, with an average of 4.28% Table1. From Fig. 6 can be seen the organic matter values Within the no permissible limits, because the percentage of organic matter in the soil varies between 2% and 3% in terms of soil strength and compressibility [21], secondary compression measures may be used to reduce future settlement

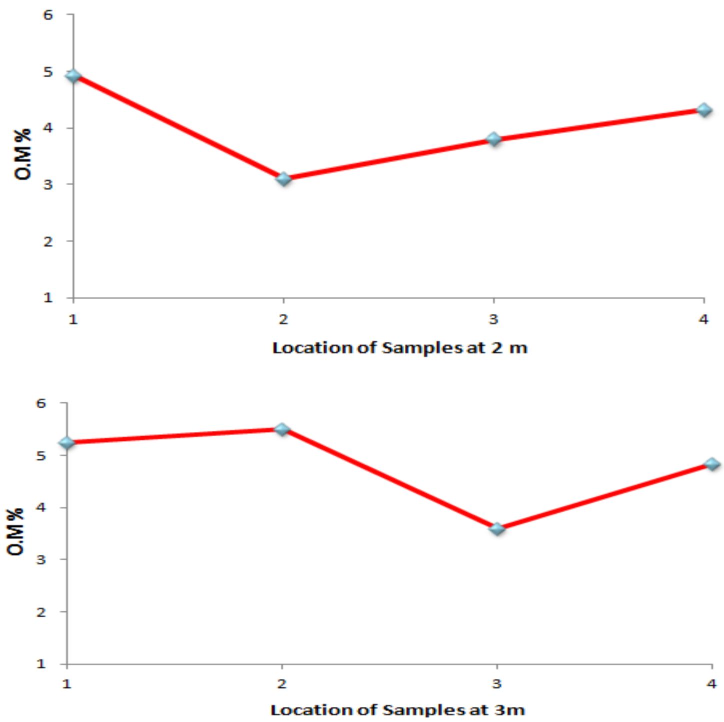

Fig. 6. Distribution of Organic Matter in Boreholes of the Study Area

Conclusions

Considering the results of this research; the following conclusions are drawn:

1.The sulfates in the study area are safe and did not exceed the effective value in the engineering behavior of the soil and do not pose a danger to the concrete.

2. Gypsum concentrations in the study are within the effective limits, creating a future engineering issue.

2. Chloride ions at the study area may attack the reinforcing steel, foundations, and leading to eating and ripping with time.

3. The organic matter values are within the no permissible limits, changes of soil strength and compressibility at the study area, and in the future limited settlements are expected.

References

1- Li, J., Pu, L., Han, M., Zhu, M., Zhang, R., and Xiang, Y. (2014). Soil salinization research in China: advances and prospects. *J. Geogr. Sci.* 24, 943–960. doi: 10.1007/s11442-014-1130-2.

2- Al-Obaidi, A., Ihssan, A., Allawi, H., (2018). Studying the effect of the combined salt on the engineering properties of clayey soil. MATEC Web of Conferences 162, 01011 https://doi.org/10.1051/matecconf/201816201011 *BCEE3*.

3- AL-Marsoumai, A .M., Khadim, S.K., and Aboud, M.A., (2009) . The Effect of Dolomite on Some Geotechnical Properties of Khor Abdullah Soil –Northwest Arabian Gulf. Journal of Basrah Researches (Sciences), 5, 17-21.

4- AL-Adili, A. and Sabih, M., (2019). Effect of Salty Soil on Subsurface Concrete Strength, International Journal of Civil Engineering and Technology (IJCIET), 10, (01), January, 2556–2565.

5- Baker, A.M., (1998). The Geotechnical Maps of Iraq (Southern Region) Unpublished M.Sc. Thesis, Uni. of Baghdad, 232p.

6- Gadouri, H., Harichane, K., and Ghrici, M., (2017). Effect of Calcium Sulphate on the Geotechnical Properties of Stabilized Clayey Soils. Period. Polytech. Civil Eng. *61(2), 256–271, https://doi.org/10.3311/PPci.9359.*

7- National Center for Construction Laboratories (2001. Specifications of materials and construction works. Baghdad 196p. (in Arabic).

8- Fattah, M. Y., Al-Shakarchi, Y. J, and Al-Numani, H. N., (2008). Long-Term Deformation of some Gypseous Soils, Eng. and Tech. 26, (12).

9- Ahmed, F., Said, M., and Najah, L., (2012). Effect of leaching and Gypsum content on Properties of Gypseous soil. International Journal of Scientific and Research Publication. 2, (9), 2250-3153.

10- Alzaidy, M. J., (2020). Effect of gypsum content on unsaturated engineering properties of clayey soil. International Journal of Engineering and Technology 9 (1), 84-91. DOI:10.14419/ijet.v9i1.30139

11- AL-Saoudi, N. S., Rahil, F.H., and AL-Soudany, K. Y., (2011). Improvement of Ballast embankment resting on soft clay by reed and asphalt layers. Engineering and Technology journal, 29 (15), 3224-3241.

12- Gadouri, H., Harichane, K., and Ghrici, M., (2017). Effect of Calcium Sulphate on the Engineering Properties of Stabilized Clayey Soils. International Symposium on Construction Management and Civil Engineering (ISCMCE), November 15 – 16,Skikda, Algeria.

13- British Standard: 1377-3,(1990).Methods of test for soil civil engineering purpose, part 3, chemical and electrochemical test.

14- Abood, T.T., Kasa, A. B., and Chik, Z. B., (2007). Stabilization of Silty Clay Soil Using Chloride Compounds. Journal of Engineering Science and Technology, 2.(1), 102–110.

15- Goudie, A., and Viles, H., (1997). Salt Weathering Hazards. Wiley, England. 256p.

16- AL-Agaa, A.M., (2006). Corrosion in facilities and their negative effects. Al-Aqsa University Journal, (10), 122-144.

17- Ren, J., Xiaojie, L., Zhao, Xingming Zhang, Jiang, T., (2019) Quantitative Research on the Relationship between Salinity and Crack Length of Soda Saline-Alkali Soil. Pol. J. Environ. Stud. 28 (2), 823-832.

18-Panpan, X., Qiying, Z., Hui, Q., and Wengang, Q., (2020). Effect of Sodium Chloride Concentration on Saturated Permeability of Remolded Loess. Article, MDPI.10, (2), 199.

19- AL-badran, B., and AL-badran A., (1997). Distribution of Bearing Strata and their Engineering properties in Basrah Region, South of Iraq. Basrah journal of science, 15, (1), 99-104.

20- Rashid, M.A., and Brown, J. D., (1975). Influence of Marine Organic Compounds on the Engineering Properties of a Remolded Sediment. Eng., Geol., 9, 141-154.

21-Scott, C.R., (1980). An Introduction to Soil Mechanics and Foundations. Third ed. Applied Science Publishers Ltd. London, 406p.

22-Al- Rawi, O., Assaf, M., and Rawashdeh, T.M., (2017). Effect of Organic Content on the Engineering Properties of Jordanian Clayey Soil. International Journal of Civil Engineering and Technology (IJCIET) 8, Iss. 11, Nov., 1018-1026, Article ID. IJCIET_08_11_100.

23- Al-Sayyab, A., Al-Ansari, N., Al-Arawi, D., Al-Jassem, J., Al-Omari, F., Al-Shaikh, Z., (1982). The Geology of Iraq, Mosul University press, Mosul. Iraq. 280 p.(in Arabic)

24-Buday, T. and Jassim, S. Z., (1987). The Regional Geology of Iraq: Tectonics, Magmatism, and Metamorphism. In: Kassab, I.I. and Abbas, M.J., Eds., Geology of Iraq, Geologic Survey, Baghdad, p352.

25- Aqrawi A .A., Goff, J.C., Horbury, A.D., Sadoon, F.N., (2010).The Petroleum Geology of Iraq. Secntific Press ltd. UK, 435p.

26-AL-Husseini, M.I.,(2000). Origin of the Arabian Plate Structure: Amar Collision and Najd Rift . GeoArabian,5,527-542.

27- Jassim, S. Z., and Buday, T., (2006). Late Turonian-Danian Megasequence AP9. In: Jassim, S.Z. and Goff, T (eds.), Geology of Iraq. Publication of Dolin, Prague and Moravian Museum, Brno, 341p.

28- Daham, H. A., AL-Marsomi A.H., and.AL-Badran, B.N. , (2001). The Fluctuation of Ground Water on Mechanical Properties of Soil in Basrah. Marina Mesopotamica , 16 (2), 273-287 .

29- Petrukhin, V. P. and Arakelyan, E. A., (1985). Strength of Gypsum Clay Soils and its Variation During the Leaching of Salts. Soil Mechanics and Foundation Engineering, 21 (6), 23-25.

30- Abood. M. K., (1993).Treatment of Gypseous Soils with Sodium Silicate. Unpublished M.Sc. Thesis, Building and Construction Dept., University of Technology, Baghda

IRAQI Academic Scientific Journals

Samarra Journal of Pure and Applied Science

SJPAS
مجلة سامراء للعلوم الصرفة والتطبيقية

www.sjpas.com

p ISSN: 2663-7405
e ISSN: 2789-6838

تقدير الاملاح والمواد العضوية في ام قصر، البصرة

هدى احمد دحام

قسم الجيولوجي، كلية العلوم، جامعة البصرة، البصرة، العراق

https://doi.org/10.54153/sjpas.2022.v4i1.339

معلومات البحث:

تأريخ الاستلام: 2021/12/19
تأريخ القبـــول:2022/01/16

الكلمات المفتاحية:

الذرة الصفراء، طرق التحفيز، صفات الأنبات

معلومات المؤلف

الايميل:huda.daham@uobasrah.edu.iq
الموبايل:

الخلاصة:

اجريت هذه الدراسة في ام قصر التي تقع في قضاء الزبير، في البصرة. ركز منهاج البحث على دراسة محتوى التربة من الكبريتات والكلوريدات والمادة العضوية. يهدف البحث الى قياس تراكيز الاملاح والمادة العضوية في التربة ومقارنتها مع المواصفات القياسية، ومعرفة هل هذه التراكيز توثرعلى سلوك الهندسي للتربة ام لا. اختيرت 4 مواقع للنمذجة بعمق 3 متر، وتم اخذ 12 نموذجا مخلخلا، اجريت الفحوصات الكيميائية لها. من خلال الدراسة وجد ان معدل الكبريتات في التربة 0.55% ,والجبس4.75% والكلوريدات 0.35%, والمادة العضوية 4.28%, كذلك تبين من الدراسة ان محتوى التربة الجبس والمادة العضوية والكلوريدات ضمن الحدود المؤثرة على السلوك الهندسي للتربة ماعدا الانواع الاخرى للكبريتات كانت ضمن الحدود غير الموثرة، وبينت الدراسة ان تذبذب محتوى التربة من الاملاح والمادة العضوية من موقع لاخر ولاعماق مختلفة قابل للتغيير مع الزمن لتاثره بعوامل جيولوجية وبيئية في منطقة الدراسة .