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The Validity of the Quaternary Deposits as a Filling Materials in Embankment Dames in Al-Shirqat City / Northern Iraq

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ABSTRACT

The research aims to show the validity of the quaternary sediments in the north of Al-Shirqat district as filling materials for dams. Samples were collected from (4) stations representing these sediments in the region. Geotechnical examinations showed that the sediments of this region are clay of low plasticity (CL) and alluvial (ML) having the values of specific weight ranged between (2.65-2.71). Chemical analyzes showed that the gypsum ranges between (1.35-8.08) %, and the percentage of total soluble salts ranged between (3.61-11.52) %, while the pH values were between (8.00-8.11). When comparing the results of geotechnical tests with the physical and chemical specifications of the filling soils according to the specifications of materials and construction works for the National Center for Construction Laboratories and Research, 2003, it shows that all the geotechnical properties of the second station were identical, as well as matching the volumetric gradient, liquidity limit and plasticity factor of stations (4,3,1), except for ratios of total dissolved salts and gypsum content which were out of the limits of the specifications for stations (4,3,1).

Introduction

Fill dams are among the most prevalent types of dams in the world because of their advantages, which include the use of local natural raw materials, easy to design and build, the use of a few devices and equipment in construction. The requirements for foundations are not strict compared to concrete dams as the weight of the building is dispersed by the wide base of these types of dams. Thus, it is suitable for different types of foundations, and its resistance to sitting and the effects of water pressure is greater when compared to other types. In terms of economic costs, their cost is lower compared to other types of dams **[1,2]**.

The main objective of the research is to demonstrate the validity of the use of the quaternary Sediments as filling materials in embankment dams in north of Al-Shirqat District.

The study area is located within Salah Al-Din Governorate/ North of Iraq / Al-Shirqat / North of Al-Shirqat, west of the Tigris River, between the longitude (43^{o} 13’ 00”) and (43^{o} 15' 00”) east, and two latitudes (35^{o} 33' 00”) and (35^{o} 37 '00”) north, Figure (1).

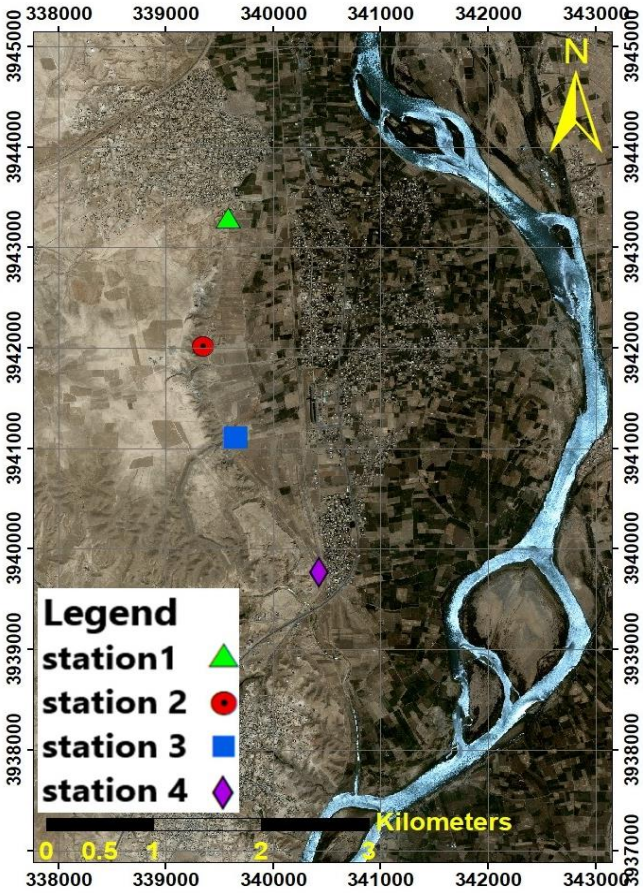

Fig.1: Location map of the study area

Geology of the Area

In the study area, the quaternary sediments will be exposed, in addition to the formation of Injana and Al-Fatha Formations. The sediments of the quaternary era, which are related to the subject of the research, will be discussed.

Quaternary Sediments

The quaternary sediments consist of sediments of the Pleistocene and Holocene. The sediments of these eras cover large areas in Iraq in the alluvial plain and the delta in the areas of river terraces and in the valleys between the ancient mountains. Climate fluctuations and periodic change in sea level during the Pleistocene era greatly affected the nature of sediments **[3]**.

The deposits of the quaternary era cover the study area, and they consist of deposits of masseuses, sand, clay, gravel, and pieces of sedimentary rocks. These sedimentary rocks are rocky crumbs that result from weathering and erosion of exposed rocks in the region and are usually a mixture of gypsum, limestone, and sand and mud rock breaks of Al-Fat-ha and Injana formations.

Methodology

Preparatory stage:

This stage includes collecting the necessary information about the study area by looking at all the researches, reports, maps and pictures of all types related to the study area as well as preparing the equipment required for field work such as a GPS device, geological hammer, special bags for sampling, punctuation pen, camera for photographing geological features and samples, tape measure and geological compass.

Fieldwork stage:

The fieldwork included conducting reconnaissance visits to get to know the geological features of the study area, and four stations (3,2,1,4) were identified. The first is the village of Al-Eithah, where sediments are revealed with a thickness of (5) m, shown in panel (1); the second is located in Wadi Al-Nukit with a thickness of (8) m, shown in panel (2); the third is located in the village of Al-Khudraniyah, with a thickness of (12-10) m, shown in panel (3); The fourth is located in the village of Al-Houriya with a thickness of (10) m, shown in panel (4). These stations were identified by the Global Position System (GPS). Fieldwork also included modeling the quaternary era sediments in the form of a trench representing the sediments of each station, and then samples of the sediments were collected from the four stations for the purpose of conducting laboratory tests to determine the suitability as filling materials for dams.

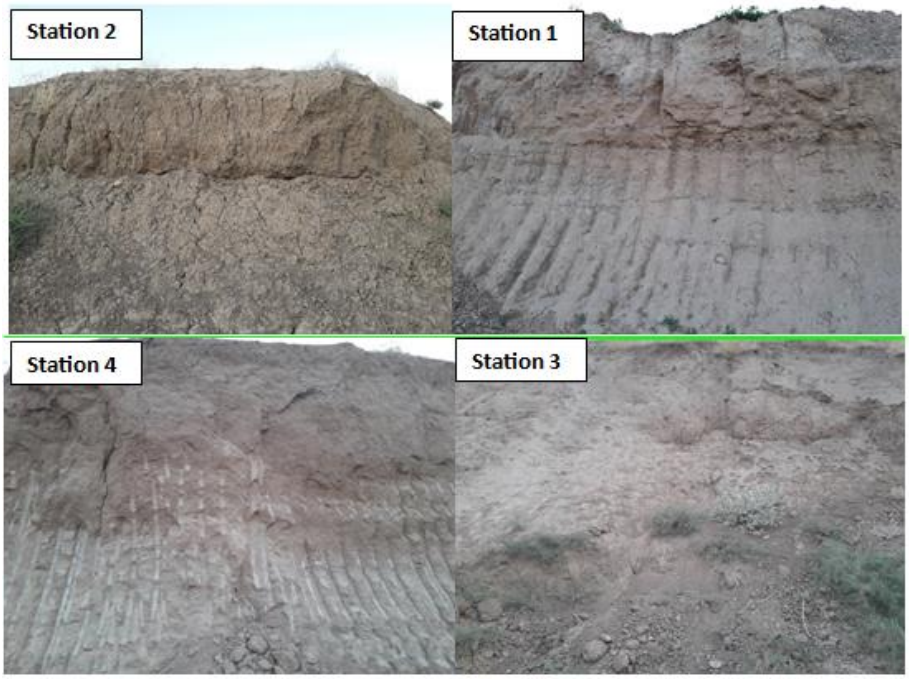

Fig. 2: The sediments stations of the study area

Laboratory work stage:

Several geotechnical examinations related to the suitability of mud were performed as filling materials in embankment dams, and these tests assist in determining how to improve the properties of the soil. These tests include (specific weight, granular volumetric analysis, Atterberg limits, gypsum content, and total dissolved salts TDS) where the physical tests help us classify the soil for engineering purposes **[4]**, and each of these tests will be discussed.

Results and discussion

Specific gravity

It is the ratio between the weights of a certain volume of soil in the air to the weight of the same volume of water at a certain temperature and was examined according to specification **[5]**. The sampling was performed from the study stations and the results are as shown in Table (1).

Table 1: Specific gravity results

Stations	Specific gravity
1	2.71
2	2.68
3	2.65
4	2.71

Grain Size Analysis

The samples were examined according to the American standard **[6]** and the specification **[7]** to find the percentage of the weight of different sizes of the soil model. There are several systems for soil classification, and the Unified Soil Classification System (USCS) was used in this study because this system is more comprehensive than other systems in the classification of soils for engineering purposes. The results of the volumetric analysis are shown in Table (2), Figures (3, 4, 5 and 6).

Table 2: Results of the granular volumetric analysis of the Stations sediments

Stations	Clay %	Silt %	Sand %
1	51	37	12
2	24	45	31
3	19	49	32
4	42	32	26

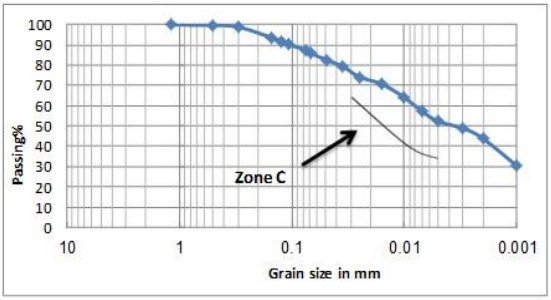

Fig. 3: Granular size analysis for the station (1).

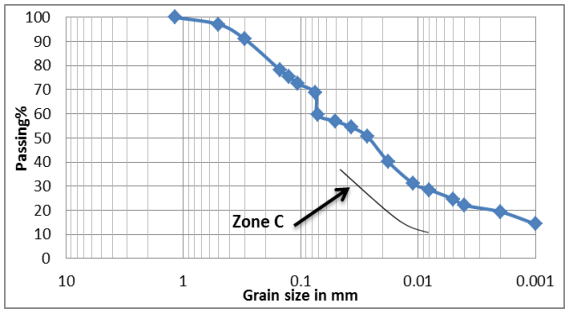

Fig. 4: Granular size analysis for the station (2).

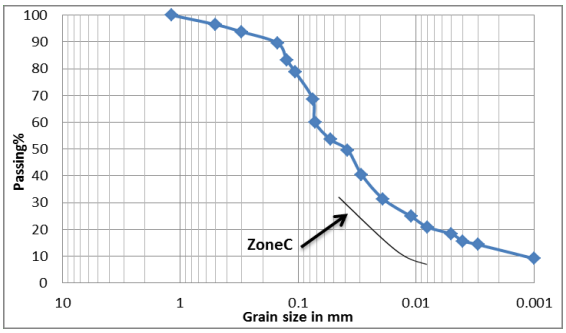

Fig. 5: Granular size analysis for the station (3).

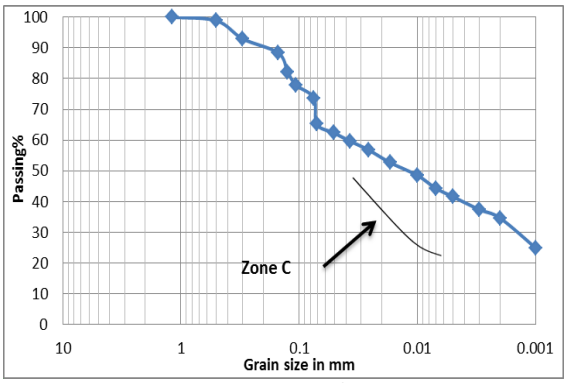

Fig. 6: Granular size analysis for the station (4).

Atterberg Limits

The most important characteristics of clay are that they are easy to form when mixed with water as the elastic dough is formed because the water reduces the cohesion of the granules, and when the amount of water increases, the cohesion decreases until the dough reaches the liquid state **[8]**. The liquid limit and plastic limit tests were performed according to the specification **[9]** and the results are as in Table (3). The results were classified in the stations according to the uniform classification **[10]** as shown in Figure (7) and Table (4).

Table 3: Atterberg Limits results of the study area stations

Stations	Liquid Limit % L.L.	Plastic Limit % P.L.	Plasticity Index % P. I
1	43	25	**18**
2	41	30	**11**
3	46	34	**12**
4	44	25	**19**

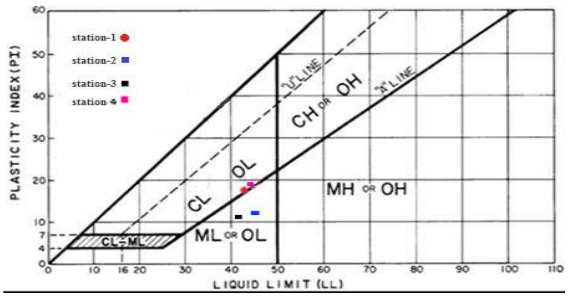

Fig. 7: Classification of the study area stations samples according to the Unified Classification

Table 4: Soil classification of the study area stations based on the Uniform Classification of Soil

Stations	Soil Symbol	Soil Type
1	CL	Low Plasticity Clay
2	ML	Low Plasticity Silt
3	ML	Low Plasticity Silt
4	CL	Low Plasticity Clay

Chemical Analyzes

Chemical analyzes of the sediments of the study area were carried out according to **[11]**, in Table (5) which included:

1- Gypsum Content.
2- Total Dissolved Salts.
3- Organic materials.
4- pH.

Table 5: Results of the chemical tests for the sediments of the study area

Stations	Gypsum %	T.D.S	Organic Materials %	pH
1	7.41	8.91	1.57	8.11
2	1.35	3.61	0.82	8.00
3	4.13	7.14	1.23	8.04
4	8.08	11.52	0.68	8.01

Geotechnical Evaluation for Study Area Deposits

In order to determine the suitability of the deposit samples to be used as raw material in building Embankment Dams, the general specification for roads and bridges is depended the (SORB \R5) national center for construction research[12] table (6).

Table 6: Physical and chemical specifications for Fills Soils [12]

Seq.	Physical and chemical specifications for Fills soils	Acceptable ranges
1	Liquid Limit	Less than 55 %
2	Plasticity Index	10-20%
3	Grains size	Corresponds to the Zone C
4	Gypsum Content	Less than 3 %
5	Total Dissolved Solids	Less than 4.4 %

To make a comparison, the study area deposit specifications are enlisted in table (7).

Table 7: Geotechnical properties of study area deposit related to the specification

Stations	T.D.S%	Gypsum %	Grains size	Plasticity Index % P. I	Liquid Limit L. L%
1	8.91	7.41	unconformable	**18**	43
2	3.61	1.35	conformable	**11**	41
3	7.14	4.13	unconformable	**12**	46
4	11.52	8.08	unconformable	**19**	44

At the final assessment for the stations samples depending on Iraqi merits (national center of labs and construction research)[12] to decide the suitability of the study area deposits as raw material in building Embankment Dams, it is found that only station (2), is conformable according to the physical and chemical properties of the specifications above. However, it is found also that stations (1,3 and 4) are unconformable to the specification above concerning chemical properties. As a final conclusion, it can be said that the study area deposits are acceptable only in station (2), because it is conformable with the general specification of building roads and bridges (SORB \R5 national center of labs and construction research 2003)[12]. Stations (1,3 and 4) are unconformable as for as chemical properties are concerned since they exceed the permitted limit table (8).

Table 8: Suitability of study area deposits in Embankment Dams according to (National center of labs and construction research 2003)

Stations Number	**Liquid Limit**	**Plasticity Index**	**Gypsum** Content	**T.D.S**	Granular Size Curve	Final Assessment
1	+	+	-	-	+	Invalid
2	+	+	+	+	+	Valid
3	+	+	-	-	+	Invalid
4	+	+	-	-	+	Invalid

(+) means conformable
(-) means unconformable

Conclusions

1- The study showed that the sediments of the study area are low plasticity clay (CL) and low plasticity silt (ML).

2- Chemical test of deposits show that the gypsum rate ranges from (1.35 to 8.08%) and the total dissolved salts ranges from (3.61 to 11.52%). The pH value ranges from (8.0 to 8.11%) and this means that it is low basal and does not effect on concrete. The value of organic material ranges from (0.68 to 1.57%) and this means that they are conformable to the specifications where they should not exceed (2%). After comparing the study area deposit properties with the Iraqi typical properties, it is found that the suitability of the quaternary Age deposits as Embankment material lies within the specification in station (2) and they are unconformable in stations (1,3 and 4).

3- Through physical tests that include plasticity factor, liquidity limit, volumetric analysis curve, it is found that the study area deposits are eligible as Embankment material in soil dams in the study area.

Recommendations

1. Study the geotechnical properties of the sediments of the study area in detail.
2. Study the thickness and extension of sediments for the purpose of calculating their reserves.
3. The best mining method for investing in these sediments is the surface mining method.
4. Conducting a study in order to calculate the amount of current sediments within the study area and to know the economic feasibility of it.

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صلاحية ترسبات العصر الرباعي كمواد املائية في السداد الترابية في مدينة الشرقاط / شمال العراق

لؤي موسى راوي

مركز بحوث الموارد الطبيعية، جامعة تكريت، تكريت، العراق

الملخص

يهدف البحث الى بيان صلاحية ترسبات العصر الرباعي في شمال قضاء الشرقاط كمواد املائية للسدود حيث تم نمذجة (4) محطات ممثلة لهذه الترسبات في المنطقة. اظهرت الفحوصات الجيوتكنيكية ان ترسبات تلك المنطقة هي من نوع طينية واطئة اللدونة(CL) وغرينية واطئة اللدونة (ML) بينما تراوحت قيم الوزن النوعي بين (2.65 −2.71), و اظهرت التحليلات الكيميائية ان نسبة الجبس تتراوح بين (1.35 −8.08)% اما نسبة الاملاح الذائبة الكلية فتراوحت بين (3.61 −11.52)% بينما سجلت قيم الاس الهيدروجيني (PH) قيم تراوحت بين (8.00 −8.11). وعند مقارنة نتائج الفحوصات الجيوتكنيكية مع المواصفات الفيزيائية والكيميائية للترب الاملائية حسب مواصفات المواد والاعمال الانشائية للمركز الوطني للمختبرات والبحوث الانشائية, 2003. تبين مطابقة جميع الخواص الجيوتكنيكية للمحطة الثانية وكذلك مطابقة التدرج الحجمي وحد السيولة ومعامل اللدونة للمحطات (4,3,1), بأستثناء نسب مجموع الاملاح الذائبة ومحتوى الجبس كانت خارج حدود المواصفة بالنسبة للمحطات (4,3,1).