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IMPROVEMENT OF COMPRESSIBILITY CHARACTERISTICS OF MODEL ORGANIC SOILS

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Abstract: The characteristics of organic soil are low permeability, low shear strength and high compressibility, therefore organic soil has to be improved before any engineering works can commence. In this study dry kaolinite is used as a clay minerals and fresh reed as an organic material for different percentages (0%, 2%, 5%, 8%, 12% and 20%) by dry weight. Lime is used as a treatment material of different percentages (0%, 3%, 6%and 9%) by dry weight. The experimental work included a series of compaction and compressibility tests conducted on 48 samples. The effect of addition of lime on compressibility characteristics of non-decomposed and decomposed model organic soil was studied. The results showed that the compressibility characteristics [compression index, rebound index, coefficient of consolidation and coefficient of secondary compression] are increased with increased organic content for decomposed and non-decomposed samples. The use of lime has improved the compressibility characteristics of organic soil.

Keywords: *organic content, lime, compressibility characteristics, (Cc), (Cr), (Cv), (Cα).*

تحسين خصائص الانضغاطية لتربة عضوية

الخلاصة: من خصائص التربة العضوية انها قليلة النفاذية و ذات قوة القص منخفضة وعالية الانضغاط. لذلك فأن التربة العضوية تحتاج الى تحسين قبل البدء في اي اعمال هندسية. في هذه الدراسة استخدم الكاولينايت كمصدر لمعدن الطين ، والقصب الطازج كمصدر للمادة العضوية وبنسب مختلفة (0، 2، 5، 8، 12، 20)% من الوزن الجاف. استخدمت النورة كمادة معالجة وبنسب مختلفة (3، 6، 9)% من الوزن الجاف. و قد شمل العمل المختبري سلسلة من الفحوصات (الرص والانضغاط) التي اجريت على 48 عينة. ثم دراسة تاثير اضافة النورة على معاملات الانضغاط للتربة العضوية النموذجية المتحللة وغير المتحللة. اظهرت النتائج ان خصائص الانضغاطية (مؤشر الانضغاط ، مؤشر الانتفاخ،معامل الانضمام و معامل الانضمام الثانوي) تزداد مع زيادة المحتوى العضوي للنماذج المتحللة و غير المتحللة. استخدام النورة ادى الى تحسين خصائص الانضغاطية للتربة العضوية.

1. Introduction

Organic materials in soil are created from decomposition of animal and plant residues. When this material incorporated in the soil is attacked by variety of worms,

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microbes and insects in the soil if the soil is moist. A large number of studies investigated the behavior of organic soil. The problems of organic soils are represented by high compressibility, poor shear strength, and high magnitude and rates of creep.

Abbass et al.[1] found that the organic content plays an important role in reducing the maximum dry density and increasing the optimum water content. Similar results were obtained by Habbi[2]. Zbar et al[3] concluded that the optimum water content and maximum dry density decreased with increasing organic matter due to decreasing the specific gravity.

Yunus[4], found that the addition of lime decreases the maximum dry density and increases the optimum water content. Rafizul et al.[5], illustrated the geotechnical properties of treated soil prepared in the laboratory by mixing bentonite, lime and cement at varying content of (5, 10, 15, 20 and 25) % of dry mass of organic soil. They found that the optimum moisture content decreases while the maximum dry density increased with increasing the admixture content.

Andersland and Al-Khafaji[6], proposed an approach for approximating the consolidation settlement of organic soil using kaolinite as a clay mineral and wood pulp fiber as organic material (slurry) in a manner independent of the compression index.

Adejumo[7],investigated the effect of organic content on consolidation characteristics of organic clayey soils. It was found that the increase in organic content leads to increase the initial void ratio. It was further shown that at lower stress, high organic content clay samples experienced significant decrease in void ratio with a little increase in pressure. The compression index (Cc) was increased (parabolic variation) with the increase in organic content

Thiyyakkandi and Annex[8], showed that the coefficient of consolidation (Cv) is decreased (parabolic) with the increase in organic content. Rabbee and Rafizul[9], determined the coefficient of consolidation by using log fitting method, and illustrated that this coefficient is generally increases with the increase in consolidation pressure and the organic content

Wardwell and Nelson[10], studied the effect of organic materials on the coefficient of secondary compression ($C\alpha$). They illustrated that ($C\alpha$) increases with increasing the organic content which cause a large void ratio in the soil mass.

Therefore organic soil has to be improved before starting any engineering works. The improvement can be represented by replacing the soil in the site with the superior material or; change the engineering properties of in situ soil according to standard requirement by adding another materials which known as soil stabilization[11].Chemical stabilization methods are presented to provide mitigation of total and differential settlements, soil strength improvement, reduced construction costs, shorter construction period, and other characteristics which may influence on their operation to specific projects on organic soil.

2. Experimental Work

2.1 Materials

1. Soil: the kaolinite clay, taken from local market, was used as a soil mass.
2. Organic Materials: The fresh reeds as a source of organic materials were taken from AL-Talbiya in Baghdad city is air dried, chopped to small pieces and then sieved. The materials passing sieve No.10 and retained on sieve No.200 were considered as fibrous organic materials.
3. Lime: Quick lime was used as a treatment material taken from local market.

2.2 Preparation of soil samples

The soil samples were mixed with fresh reed in two different methods:

The first method by mixing dry kaolinite as clay minerals with fresh reed as a source of organic materials at different percentages (0, 2, 5, 8, 12, 20) % by dry weight of soil. Then each sample (with a certain percentage of fresh reed) was stabilized by adding three different percentages of lime (3, 6, 9)% by dry weight of sample.

The second method by mixing kaolinite with fresh reed at different percentages (0, 2, 5, 8, 12, 20) % by dry weight of soil at a saturation condition. Saturation condition was checked by left the samples in a bucket for six months soaked in water to achieve decomposition of organic material. After this period of soaking the samples were air-dried, grinded and sieved to remove the non-decomposed reed materials. Each sample was stabilized by adding three different percentages of lime (3, 6, 9) % by dry weight of sample.

2.3 Laboratory investigation

The Physical and classification properties of kaolinite are shown in Table (1) while the chemical properties of Kaolinite and lime are showed in Tables (2) and (3) respectively.

Table (1) Physical and classification properties of kaolinite.

Properties	Value	Standard
Specific Gravity (Gs)	2.63	ASTM D 854-00
Liquid Limit (L.L.)%	51.45	B.S.1377:1975
Plastic Limit (P.L.)%	28	B.S.1377:1975
Plasticity Index (P.I)%	23.45	
Standard Compaction Test		
Maximum dry unit weight	15.84	
ɣd max. (kN/m3)		ASTM D698-78
Optimum water content (%)	22.21	
(o.w.c)		
Unified Soil Classification System (USCS)	CH*	ASTM D2487-06

* CH: Clay of high plasticity.

Table (2) Chemical composition of kaolinite.

Chemical Element	Percent (%)
SiO_2	50.9
Al_2O_3	42.3

CaO	2.4
Fe2O3	1.7
MgO	0.8
Loss of Ignition	1.8

Table (3) Chemical composition of lime.

Chemical Element	Percent (%)
CaO	69.8
MgO	2.4
Fe2O3	1.9
AL2O3	1.2
SiO2	2.3
SO3	0.5
CO2	2.7
Loss of Ignition	19.1

2.4 Testing program

A detailed testing program was conducted on the modeled organic soil. All tests are summarized in the flow chart shown in Figure (1).

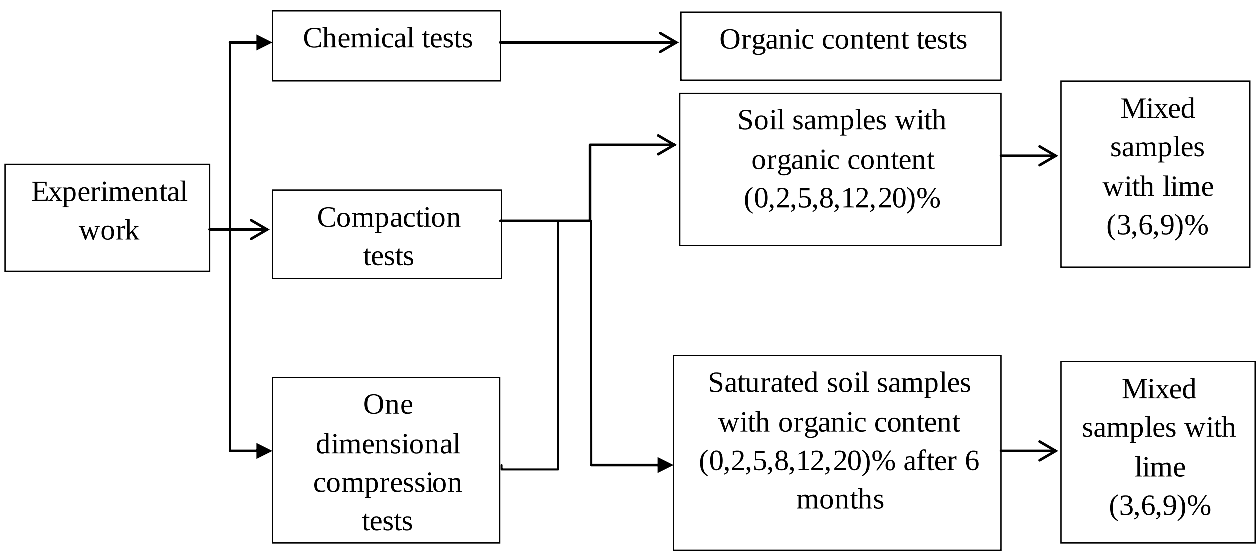

Figure (1) Flow chart of testing program.

2.5 Organic content test

Ignition method is used in this study to determine the percent of organic content in the soil according to ASTM D2974. The results of organic content tests by the ignition method are summarized in Table (4) after the decomposition of soil samples.

Table (4) Results of Ignition test method for samples after 6 months of saturation.

Organic content (O.C %)	
Before	after
2	1.83
5	4.62
8	6.92
12	10.96
20	13.79

2.6 Compaction Tests

The standard compaction effort is used according to ASTM D698-78 specification.

2.7 One Dimensional Compression Tests

The one dimensional compression test is performed according to the conventional procedure recommended by (ASTM D2435-80). The samples are prepared by calculate the sample weight corresponding to 90% of maximum dry unit weight at an optimum water content, according to Equation (1).

$$w = (8.1101 \times \gamma_{d\ max.}) \times (1 + O.W.C). \quad (1)$$

4. Result and Discussion

4.1 Physical Properties

The physical properties which are investigated in this study include the specific gravity for non-decomposed and decomposed samples. The values of specific gravity of samples are presented in Table (5). The obtained results are calculated from Equation (2)[12], depending on the values of specific gravity of natural soil equal to (2.63), organic material (1.67) and lime equal to (2.52).

$$G = \frac{G_s G_p}{(G_s - G_p)P + G_p} \quad (2)$$

Table (5) Values of specific gravity for both non-decomposed and decomposed sample.

Non-decomposed			Decomposed		
O.C %	Lime %	G	O.C* %	Lime %	G
	0	2.63		0	2.63
	3	2.627		3	2.627
0	6	2.623	0	6	2.623
	9	2.619		9	2.619
	0	2.6		0	2.603
	3	2.598		3	2.6
2	6	2.595	1.83	6	2.598

	9	2.593		9	2.595
	0	2.557		0	2.562
	3	2.556		3	2.561
5	6	2.555	4.62	6	2.559
	9	2.554		9	2.558
	0	2.514		0	2.529
	3	2.514		3	2.528
8	6	2.514	6.92	6	2.528
	9	2.515		9	2.528
	0	2.46		0	2.474
	3	2.462		3	2.475
12	6	2.464	10.96	6	2.477
	9	2.465		9	2.478
	0	2.36		0	2.437
	3	2.365		3	2.439
20	6	2.369	13.79	6	2.442
	9	2.374		9	2.444

* After decomposition of organic material.

4.2 Compaction tests

The results of the compaction tests are shown in Tables (6) and (7) for non-decomposed and decomposed samples respectively. The maximum dry density is decreased with increasing the organic content for each percent of lime in both cases (non-decomposed and decomposed samples), while no significant effect was noticed with increasing lime content for all percent of organic content except 12% and 20% organic contents for non-decomposed samples. At these two organic contents, the maximum dry density was continuously increased due to the addition of lime. These results may be related to the effect of specific gravity of samples (increasing specific gravity leads to increase max. dry density).

The optimum water contents were increased with increasing the organic content for each percent of lime in both cases, while no significant effect can be recognized when added lime for each percentage of organic content and for both non-decomposed and decomposed samples. These results are due to the insufficient time required to complete the reaction between the lime with soil particles and lime with organic content.

Table (6) Value of maximum dry density for organic soil with different percentage of lime.

(a) Non-decomposed samples.

%O.C % Lime	0	2	5	8	12	20
0	15.48	14.58	13.82	12.99	12.29	10.74
3	15.16	14.52	13.87	13.35	12.87	11.11
6	15.25	14.55	13.89	13.37	12.83	11.11
9	15.28	14.56	13.75	13.39	12.85	11.11

(b) Decomposed samples.

%O.C % Lime	0	1.83	4.62	6.92	10.96	13.79
0	15.48	14.39	14.31	14.07	13.88	13.52

3	15.16	14.09	14.04	13.95	13.72	13.18
6	15.25	14.13	14.02	13.91	13.68	13.21
9	15.28	14.05	14.07	13.98	13.73	13.24

Table (7) Value of optimum water content for organic soil with different percentage of lime.

(a) Non-decomposed samples.

%O.C / % Lime	0	2	5	8	12	20
0	22.21	24.4	27.76	25.77	25.77	35.29
3	21	21.87	23.4	26.4	26.4	31.9
6	22.92	22.7	22.4	27.72	27.72	32.7
9	20.67	24.2	18.2	26.68	25.96	31.8

(b) Decomposed samples.

%O.C / % Lime	0	1.83	4.62	6.92	10.96	13.79
0	22.21	25.75	26.67	28.49	28.68	28.98
3	21	26.87	25	27.01	28.3	27.34
6	24.14	27	25.49	27.56	28.57	27.78
9	24.66	28.13	28.02	27.87	28.98	28.43

4.3 One Dimensional Compression Tests

4.3.1 Compression index (C_c) and rebound index (C_r)

The results of one dimensional compression test on non-treated and treated, non-decomposed and decomposed model organic soils are presented in Tables (8) and (9), respectively. The compression indices (Cc) are increased with increasing organic content for both types of samples for each percent of lime content except at 5% organic content of treated non-decomposed sample. The compression index of 0% organic content sample is decreased with increasing lime content. Also, the compression indices for decomposed organic soil samples are decreased with increasing lime content for all samples of different percentage of organic content. While the behavior of non-decomposed organic samples are uncontained depends on the percent of organic material and lime. This may be due to the fact that the lime effects need a certain situation such as complete saturation of sample in addition to enough time to complete the reaction with clay particles. These conditions were not available for non-decomposed samples. The increase in compression index can be attributed to increase in organic content lead to increase in the void ratio which increased compressibility. On the other hand, addition of lime lead to bonding of soil particles which increased the soil resistance to applied stresses.

The value of rebound indices depends on the percentage of organic material and lime content in addition to the type of sample (decomposed or non-decomposed). There is no general trend of variation of these values. It may depend on many factors; the most important one is the interaction between organic fibers and soil particles. Also, the interaction of both materials with lime and the chemical reactions which may developed between these materials.

Table (8) Summary of compression tests results for non-decomposed samples with different percentage of lime.

Properties	%Lime	O.C.% 0	2	5	8	12	20
ɣd(kN/m3)	0	13.95	13.25	12.766	11.5	11.16	9.822
	3	13.58	13.115	12.2	11.86	11.714	9.9191
	6	12.843	13.05	12.143	12.07	11.676	9.9314
	9	13.713	13.204	12.056	12.1	11.669	9.81
%ofγ_d max.*	0	90.18	90.85	92.37	88.53	90.81	91.45
	3	89.578	90.324	87.96	88.84	91.02	89.281
	6	91.01	89.691	87.423	90.28	91.01	89.391
	9	90.395	90.687	87.68	90.366	90.81	88.299
e_0	0	0.849	0.9272	0.9837	1.154	1.172	1.375
	3	1.0954	0.944	1.0794	0.8052	1.0721	1.2499
	6	1.0034	0.9531	1.0826	0.781	1.0799	1.187
	9	0.9292	0.9268	1.0959	0.816	1.0822	1.2547
w.c.(%)	0	23.42	29.69	32.47	27.27	36.53	37.39
	3	22.41	34.71	36.499	34.363	33.203	32.24
	6	24.63	36.79	36.44	31.27	33.824	32.97
	9	25.03	34.894	37.791	35	32.559	32.28
Cc	0	0.1997	0.2138	0.2603	0.2394	0.3169	0.4497
	3	0.1736	0.2579	0.23	0.3136	0.3985	0.4234
	6	0.0837	0.23682	0.218	0.2396	0.313	0.4671
	9	0.0634	0.2291	0.1876	0.2829	0.361	0.5121
Cr	0	0.0538	0.0615	0.0769	0.0454	0.0469	0.0813
	3	0.0149	0.0258	0.0254	0.0286	0.0469	0.0816
	6	0.01986	0.0449	0.019	0.0279	0.0318	0.0415
	9	0.02153	0.0328	0.0329	0.0306	0.0387	0.0466

*% of $\gamma_{d\ max} = \gamma_{d\ used} / \gamma_{d\ max}$.

Table (9) Summary of compression tests results for decomposed samples with different percentage of lime.

Properties	%Lime	O.C% 0	1.83	4.62	6.92	10.96	13.79
ɣd(kN/m3)	0	13.95	12.95	12.852	12.632	12.57	12.259
	3	13.58	12.801	12.688	12.58	12.34	11.7101
	6	12.843	12.572	12.686	12.289	12.38	12.02
	9	13.713	12.437	12.508	12.68	12.292	11.808
% of $\gamma_d$max*	0	90.18	89.99	89.81	89.78	90.56	90.67
	3	89.578	90.851	90.37	90.175	89.942	88.85
	6	91.01	88.975	90.485	88.35	90.497	90.99
	9	90.395	88.516	88.898	90.7	89.527	89.18
e_0	0	0.849	1.144	1.0491	1.2025	1.2563	1.661
	3	1.0954	0.992	0.9799	1.0565	1.163	1.043
	6	1.0034	1.0382	0.9787	1.0496	1.148	0.9597
	9	0.9292	1.0467	1.0061	1.0697	1.143	0.94719

w.c.(%)	0	23.42	26.143	27.37	29.364	30.67	30.52
	3	22.41	29.69	25.77	28.85	28.714	28.125
	6	24.63	28.696	27.368	27.5	29.53	29.289
	9	25.03	30.099	28.824	27.083	29.355	29.074
Cc	0	0.1997	0.2841	0.2958	0.3786	0.5163	0.5195
	3	0.1736	0.2293	0.2347	0.3481	0.27301	0.3136
	6	0.0837	0.221	0.2248	0.3367	0.2573	0.3128
	9	0.0634	0.2077	0.2056	0.3201	0.2389	0.242
Cr	0	0.0538	0.0364	0.033	0.0507	0.0311	0.025
	3	0.0149	0.0243	0.02875	0.0307	0.0327	0.0475
	6	0.01986	0.0391	0.0309	0.0327	0.03301	0.0535
	9	0.02153	0.0325	0.0213	0.0332	0.0317	0.0503

*% of $\gamma_{d\,max} = \gamma_{d\,used} / \gamma_{d\,max}$.

4.3.2 Coefficient of consolidation (C_v)

The results of non-decomposed and decomposed samples for different lime content are summarized in Tables (10) and (11). Square root time method is used to determine the coefficients of consolidation for samples. The general trend of variation of Cv is the value of Cv are increased with the increase of organic content and with increase of consolidation pressure for each percent of lime content and for non-decomposed and decomposed samples. While the values of Cv are decreased with the increase of lime content for all consolidation stresses and for each percentage of organic content and for non-decomposed and decomposed samples. The increase in organic content causes an increase in the void ratio then increase in permeability which cause increase in the values of Cv . On the other hand, the addition of lime causes pozzolanic reaction taking place within the soil which in turn changes the soil matrix. The adsorbed cations of the clay mineral exchanges with the free calcium in lime, which decrease the size of spread water layer surrounding the clay particles meant causing agglomeration/flocculation of the clay particles, which changes the clay into a more sand-like or silt-like materials[13].

Table (10) Values of Cv(m2/yr) for non-decomposed samples with different percentage of lime.

P(kPa)	%O.C / %Lime	0	2	5	8	12	20
25	0	0.53	0.63	0.94	2.53	1.65	5.93
	3	0.44	0.53	0.63	1.61	0.94	3.73
	6	0.36	0.51	0.46	1.29	0.72	2.81
	9	0.34	0.48	0.56	0.82	0.58	2.87
50	0	0.72	0.97	1.57	1.94	6.2	6.72
	3	0.71	0.84	0.94	1.92	4.26	6.32
	6	0.64	0.82	0.75	1.58	3.57	6.04
	9	0.62	0.74	0.83	1.49	3.18	5.73
100	0	0.93	1.53	1.94	5.28	6.82	7.04
	3	0.73	1.04	1.27	4.91	3.72	6.47
	6	0.66	0.84	1.03	3.72	3.42	6.25
	9	0.53	0.76	1.06	3.85	2.81	5.83
200	0	1.04	1.96	2.85	6.65	7.92	7.83
	3	0.94	1.37	1.67	5.84	5.62	6.74
	6	0.73	1.02	1.03	4.95	5.23	5.83

	9	0.58	0.82	0.93	4.19	4.71	5.27
	0	1.58	2.71	3.94	6.92	8.34	9.05
	3	1.04	2.38	2.93	4.52	6.82	4.61
400	6	1.35	1.09	2.59	4.04	6.43	4.46
	9	1.02	1.06	2.14	3.58	5.72	3.66
	0	4.05	5.62	6.04	7.51	11.36	9.96
	3	3.64	4.53	5.31	6.36	6.28	6.64
800	6	3.28	4.02	5.21	5.74	6.82	6.18
	9	3.01	3.72	4.36	5.38	7.42	5.17

Table (11) Values of Cv(m2/yr) for decomposed samples with different percentage of lime.

P(kPa)	%O.C %Lime	0	1.83	4.62	6.92	10.96	13.79
	0	0.53	1.01	2.73	3.93	2.25	5.93
	3	0.44	0.82	1.34	1.72	1.54	4.13
25	6	0.36	0.61	0.92	1.37	1.41	3.72
	9	0.34	0.47	0.73	1.16	0.84	3.51
	0	0.72	1.62	2.93	4.35	2.83	6.92
	3	0.71	1.93	2.42	3.16	1.52	5.25
50	6	0.64	0.93	1.83	2.82	2.9	4.82
	9	0.62	0.82	1.74	2.72	1.24	4.04
	0	0.93	1.93	3.56	6.39	5.82	7.94
	3	0.73	1.63	2.45	5.12	3.79	6.47
100	6	0.66	0.78	1.45	4.25	3.22	6.25
	9	0.53	0.67	1.06	4.15	2.89	6.62
	0	1.04	2.82	5.27	7.02	6,85	8.34
	3	0.94	1.73	4.81	6.22	4.73	6.74
200	6	0.73	1.24	3.93	5.71	4.25	5.83
	9	0.58	0.92	3.47	5.16	3.92	5.27
	0	1.58	4.82	6.79	7.84	7.92	9.35
	3	1.04	2.83	5.52	6.82	6.82	7.26
400	6	1.35	1.92	4.25	6.15	6.43	7.01
	9	1.02	1.6	4.15	5.62	5.72	6.26
	0	4.05	7.02	7.92	10.82	12.02	14.04
	3	3.64	4.53	6.36	8.34	9.34	9.35
800	6	3.28	4.02	5.25	6.26	8.43	7.35
	9	3.01	3.72	4.36	6.61	7.12	6.36

4.3.3 Coefficient of secondary compression (C_α)

Figures (2) and (3) show the relation of lime content vs coefficient of secondary compression (Cα) for the non-decomposed and decomposed samples for different percentage of organic content. Cα is assumed to be the slope of axial strain versus logarithm of time curve for time period between passing 24 hours (1440 min) to becomes asymptotic after the dial gage reading becomes stable under a consolidation pressure (800) kPa. The results of non-decomposed and decomposed samples for different lime content are summarized in Tables (12) and (13). The values of Cα are increased with increasing organic content at each percent of lime for both cases, while the values of Cα generally decrease with increasing lime content for all percentage of organic soils in both cases. This is because the void ratio of soil increases with increasing organic content, which leads to increase the compressibility. On the other hand, the addition of lime causes pozzolanic reaction taking place within the soil which in turn changes the soil matrix. The adsorbed cations of the clay mineral exchanges with the free calcium of the lime, resulting in decrease in size of the spread water layer surrounding the clay particles causing agglomeration/flocculation of the clay particles, which changes the clay into a more sand-like or silt-like materials[13].

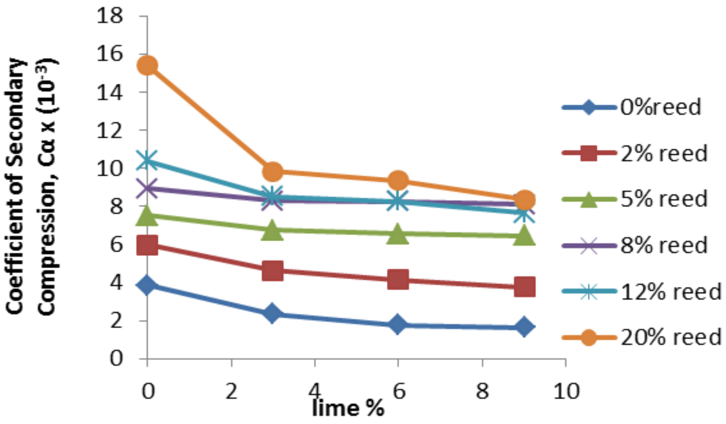

Figure (2) Effect of lime content on coefficients of secondary compression for different consolidation pressures for non-decomposed samples.

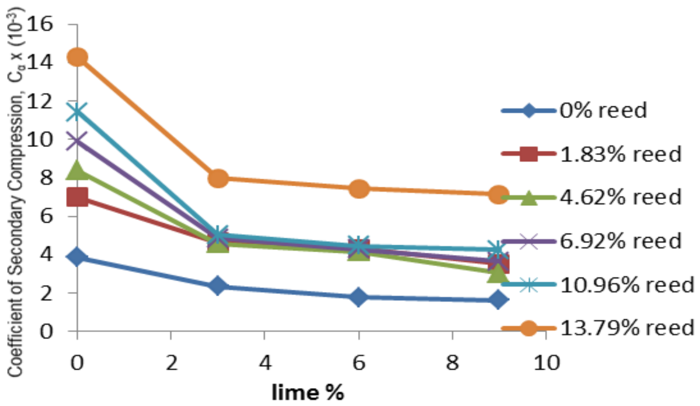

Figure (3) Effect of lime content on coefficients of secondary compression for different consolidation pressures for decomposed samples.

Table (12) Values of Cαx(10-3) for non-decomposed samples with different percentage of lime.

O.C.% Lime%	0	2	5	8	12	20
0	3.86	5.99	7.52	8.94	10.38	15.39
3	2.34	4.62	6.73	8.28	8.51	9.83
6	1.77	4.15	6.56	8.27	8.27	9.36
9	1.62	3.76	6.47	8.08	7.63	8.34

Table (13) Values of Cαx(10-3) for decomposed samples with different percentage of lime.

O.C.% Lime%	0	1.83	4.62	6.92	10.96	13.79
0	3.86	6.97	8.37	9.87	11.42	14.26
3	2.34	4.64	4.58	4.85	5.03	7.98
6	1.77	4.29	4.16	4.26	4.46	7.44
9	1.62	3.52	3.04	3.63	4.23	7.14

5. Conclusions

Based on the results from the experimental works, the following conclusions can be drawn. It was emphasized that these conclusions were limited to the variables studied:

1. The maximum dry unit weight decreases and the optimum moisture content increases with increasing the organic content for both cases.
2. The max. dry density is decreased with increasing organic content for each percent of lime for both cases, while no significant effect in the maximum dry density noticed with increased lime content for each percent of organic content for non-decomposed and decomposed samples except 12% and 20% organic content for non-decomposed samples, where the max. dry density is increased with increased lime content.
3. Increasing the organic content of soil leads to increase the compression index (Cc) for both non-decomposed and decomposed samples for each percent of lime content.
4. The compression index (Cc) for decomposed organic soil samples are decreased with increasing lime content, for all samples of different percentage of organic content.
5. Coefficient of consolidation (Cv) for both types of samples are increased with the increase of organic content and stresses. While, it is decreased with increase of lime content.
6. The value of $C\alpha$ are increased with increase organic content for each percent of lime for both cases, while the values of ($C\alpha$) generally decrease with increases of lime content for all percentage of organic soils in both cases.
7. Using lime will improve the compressibility characteristics of organic soil.

Abbreviations

G	Specific gravity of soil
Gp	Specific gravity of added material
Gs	Specific gravity of soil particles
p	Proportion of added material by dry mass
w	Required weight(gm)
ɣd	Dry unit weight (kN/m^3)
ɣdmax.	Maximum dry unit weight (kN/m^3)
ɣ d used	Dry unit weight of sample(kN/m^3)
O.W.C	Optimum water content for sample (%)

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