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# Influences of Eggshell Powder to reduce the collapse of soil gypsum

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## Abstract

Failure of different buildings built in the regions of gypsums soils in Iraq, particularly in the last three decades lead to find strategic projects to solve this problem. for this purpose, selected regions of gypsums soils in Iraq to study and find conclusions of gypsum. The investigational work includes testing of collapse soil before and after mixing gypsum soil with deferent percentage of eggshells powder (4%,8%,12% ,16% and 24%) and the cruelty the collapse potential classification . the soil before mixing is considered as Severe trouble, while after mixing the soil become no problem at 16% of eggshells powder.

**Keywords:** gypsum soil. eggshell powder, odometer test Soil collapse, classification tests

## 1. Introduction

Chicken eggshell is a waste material from domestic sources. The sources are poultries, hatcheries, homes and fast food restaurants. To facilitate easy milling, eggshells were spread on the ground and air dried for two days. The eggshells were manually broken and milled into powdery shape which were gathered in polythene bags ,after air drying . The eggshell powder was lastly sieved in 425 $\mu$  sieve. Eggshell powder was lastly sired , The eggshell powder comprises (99.83%) of CaO and be result (Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Cl, Cr<sub>2</sub>O<sub>3</sub>, MnO and CuO). , [1] Increase PI, FSI and a rise the (silt/clay) fraction The sample mixed with 8wt% eggshell powder is show. The results of the analysis have been discussed . These results can influence employ of eggshells powders for huge stabilization of soils, [2]. Eggshells comprise from calcium and trace membranes [3] amounts of other micro aspects like magnesium . nutshell membranes contain collagen as a component such as : boron, copper, iron, manganese, molybdenum, and hjoocvk sulphur, The collagen is derived and has diverse wages in silicon and zinc .Eggshell calcium is considered to be as medicine , biochemical, pharmaceutical, food and probably . It is the regarded sometimes the favorite natural source of calcium and it is cosmetics industries. [4] Confirms that these were would minimize their outcome about 90% absorbable. It is a much more environmental pollution. The eggshell or shell source of calcium than limestone or coral sources. The peels from 10.2% of the whole egg. Grind them peels comprise inner al outer membrane's into affine powder.

The make eggshell powder [5] evolved a patent for separating egg makes about one teaspoon of powder, that yields shell membranes from the eggshell. [4] Points of elemental calcium about (750-200) mgs of elemental calcium of eggshell. shell membranes include proteins as The composition of an eggshell which is very identical to that of major properties with small amounts as our bones and teeth. It is suggested that humans with carbohydrates and lipids osteoporosis yield 400-500 mg calcium per a day to the formation of the egg shell is almost 98.2 , [6] .



### 1.1. Collapsibility of Gypseous Soils

Gypseous soil refers to unsaturated soil which capes with a radical preparations of particles besides huge loss of volume upon wetting a accompanied by / lacing loading, [7. measured the collapsibility in a various way that is named single collapse test . in this test a sample is suited in the consolidate meter ring, then the load is appealed progressively till 200 KPa is held out or extended . the specimen is flooded with water and left for a clay at the and of loading . the odometer test is performed to its maximum loading . for the two samples , the (e-log p ) graph was brought in to being . in this case, the collapse potential (C.P) can be at any log pressure level in which, [8]

where:

$$C.P(\%) = \frac{\Delta H_c}{H} * 100 = \frac{\Delta e}{1 + e_o} * 100$$

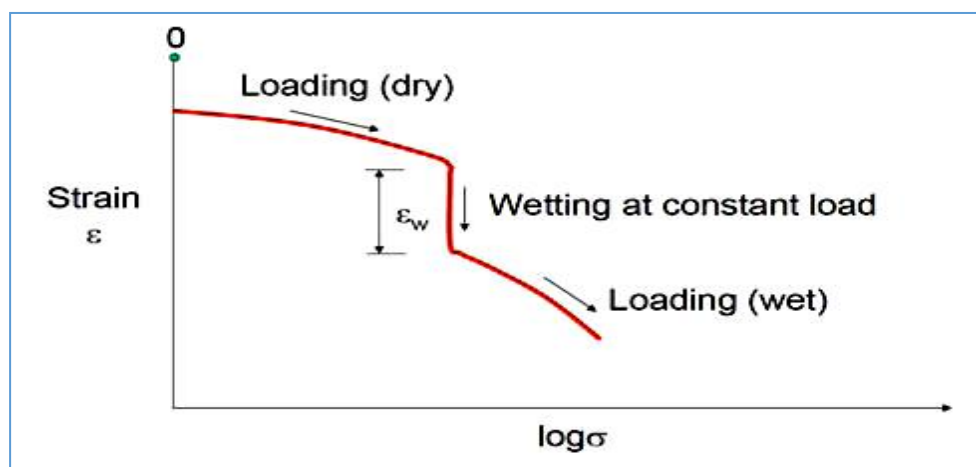
$\Delta H_c$ = change in height of the two samples

$\Delta e$ = is void ratio for two samples at the same pressure

$H$ = initial depth.

$e_o$ = void ratio is natural.

Figure 1 explains from a series of odometer tests, a curve of compaction versus log stress can be created.



**Figure 1.** Relationship (log pressure –strain) through a collapse test

Table 1. Refer to relation between values of collapse potential and type of severity of the problem [9].

Collapse Potential (Cp%)	Severity of the Problem
0-1	No problem
1-5	Moderate trouble
5-10	Trouble
10-20	Severe trouble
> 20	Very severe trouble

From compression between two regain that different into content the percentage of gypsum in the soil, notes that the collapse potential increases with increasing stress level [10]. Table (2 ) refer to the Classification of soil depend for gypsum content [11].

**Table 2.** Classification of soil depend for gypsum content

Gypsum Content %	Classification
0-0.3	Non-gypsiferous
0.3-3	Very-slightly gypsiferous
3-10	Slightly gypsiferous
10-25	Moderately gypsiferous
25-50	Highly gypsiferous
>50	Gypsiferous soil to be described by other fractions such as clayey or sandy gypsiferous soil.

## 2. Objective

The objective of this research is to study the effect addition the eggshell powder to improvement geotechnical characteristics gypsum soil .

## 3. Materials and Experimental Tests:

### 3.1 Soil Samples

The soil sample used is obtained from Iraq with gypsum content (39) The soil used can be classified as (SW-SM) according to (USCS).

### 3.2 Additives

The additives used in this study include Eggshell of calcium carbonate, a common form of calcium, protein and other minerals. Using eggshell powder processed from chicken eggs as a natural supplement to calcium is not a new innovation of its kind, but it was already the common means of obtaining calcium in the past centuries. Half a single egg shell provides an adult's daily requirement of 1000 mg. Calcium accounts for 40% of eggshell contents, resulting in about 400 mg of eggshells per gram.

## 4. Experimental Program

### 4.1 Methodology

The experimental program consisted eggshells were offtake from market-place and laundered with double dribbled water followed by drying in a whot air oven at 110C for half day (12hrs).and studies the cohesion soil at the addition the ratio of eggshell powder varying to the soil.



**Figure 2.** eggshells powder

## 5. Data Analysis and Testing Results

### *The Odometer Test and their results are*

To study the bearing of the soil to collapse, for soil gypsum a collapse test was carried out for such soil in its natural state and after treatment. The figure (3) refers to the relationship between the void ratio and log pressure for natural soil state. Figures from (4 to (8), refer to the collapse test that was carried out for such soil after treatment by addition eggshells powder (4%, 8%, 12%, 16%, and 24%) respectively. The value of the collapse is low which indicates that the eggshell works to cohesion of the soil particles. From aforementioned figures one can note the vertical line refers to the difference of void ratio for saturated soil and dry the soil at the same value of stress (200KPa), because the solutions of gypsum in water leading to bonds breaking between the particles soil. It be able to be observed that the void ratio of collapse takes place under zero pressure caused by wetting of the soil due to raising the water table to the ground surface. That behavior is dependent on percentage ratio of add eggshells powder %. to the soil due to decrease the thickness of the collapsible layer.

From table (3, and 4), as well as, figure (9) are summarized for the value of collapse percentage which is variable with the addition of eggshells powder %. Soil collapse less than with increasing eggshell ratio collapse percentage at natural soils (without add eggshell powder %) is (12.8), while to be (6.2, 5.04, 2.8, 0.98, and 0.55) at addition eggshell (4%, 8%, 12%, 16% and 24%) respectively.

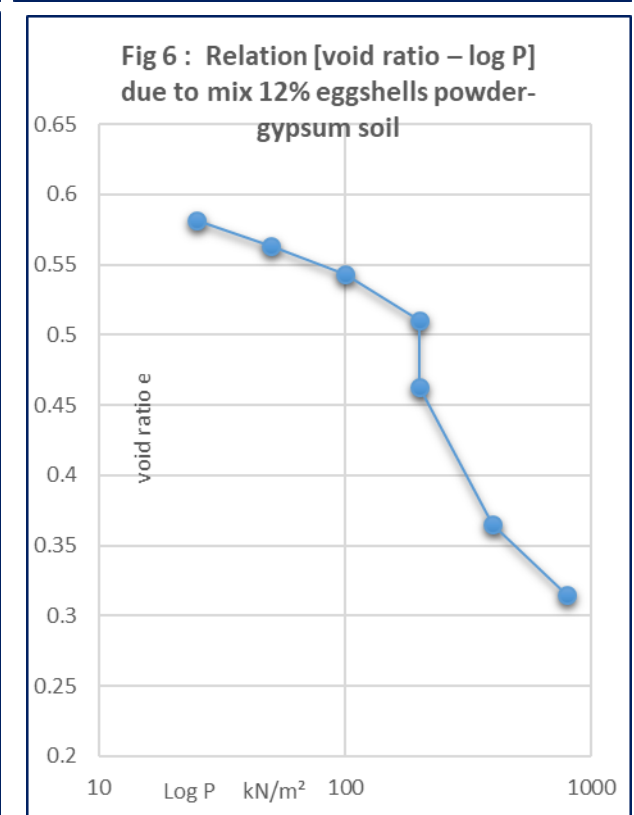
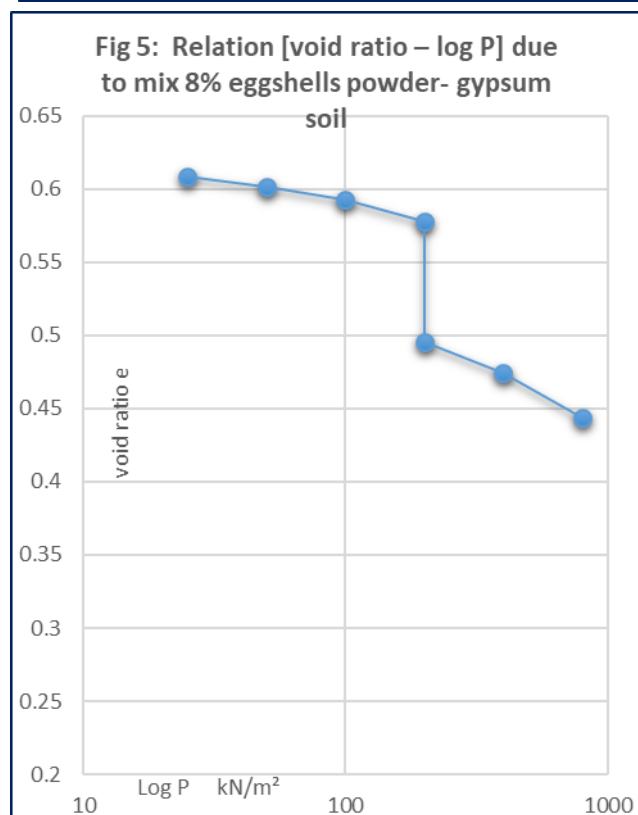
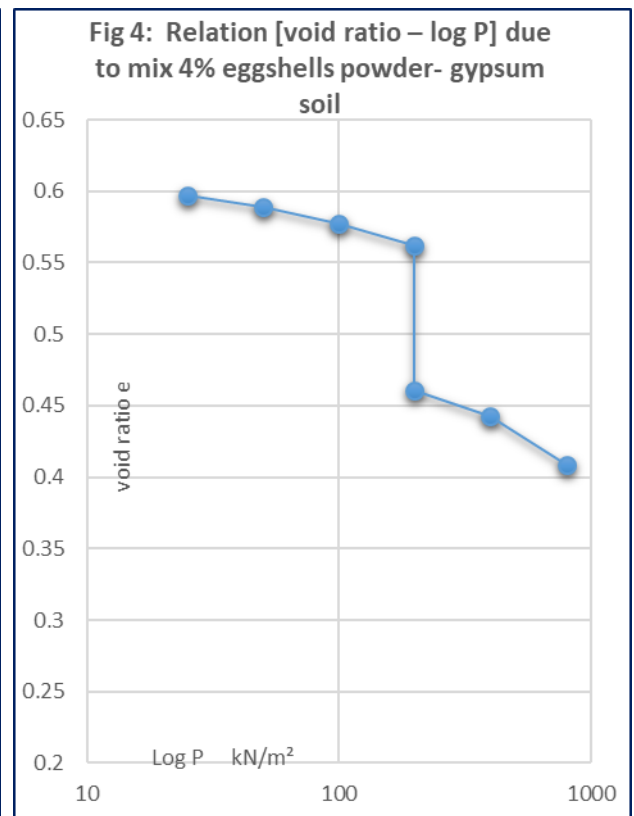
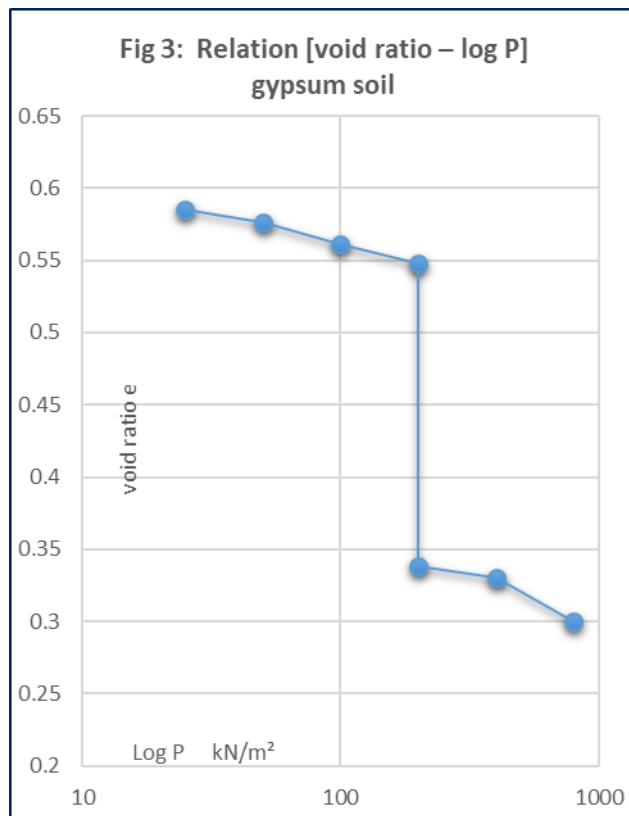
**Table 3.** The results  $\Delta e$  of the soil for all tests odometer

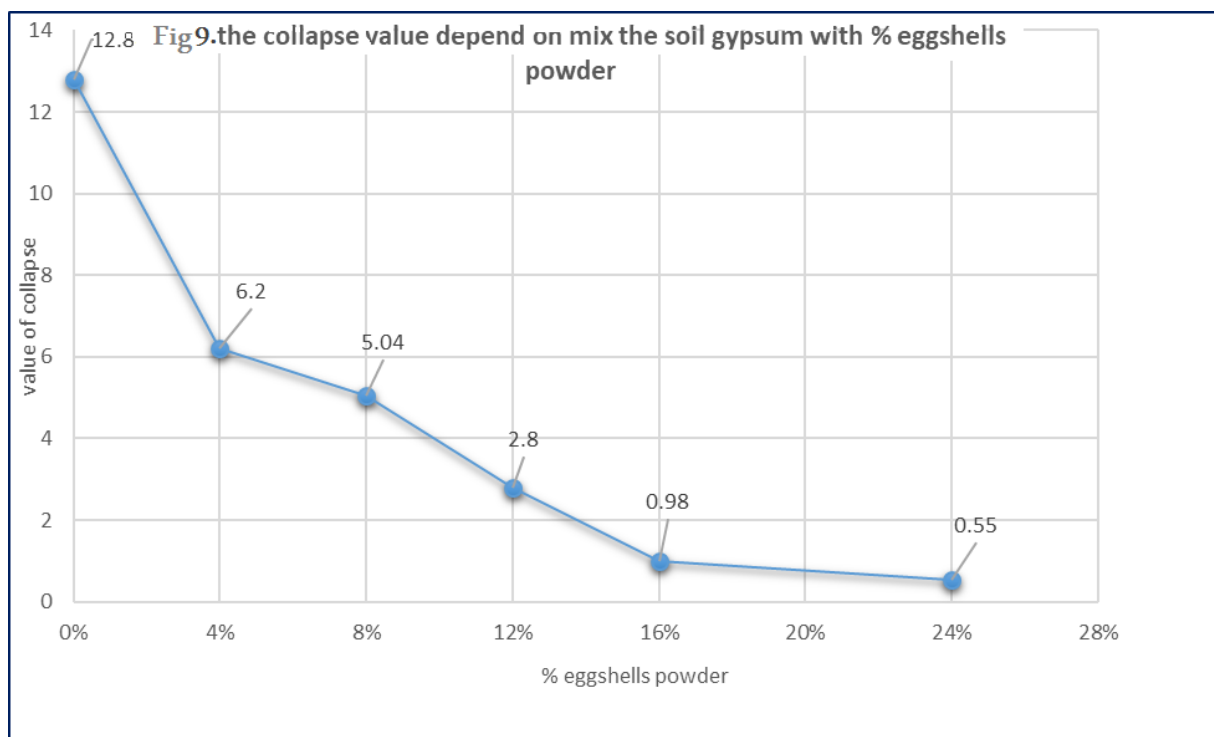
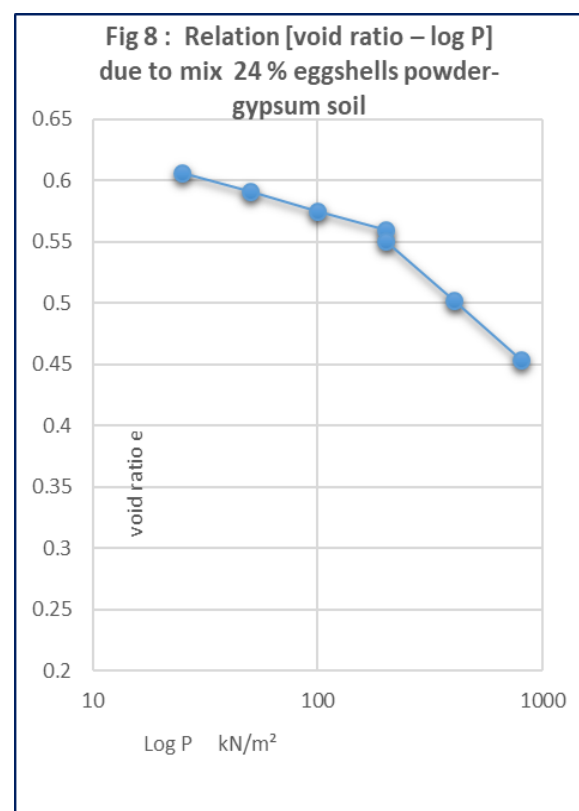
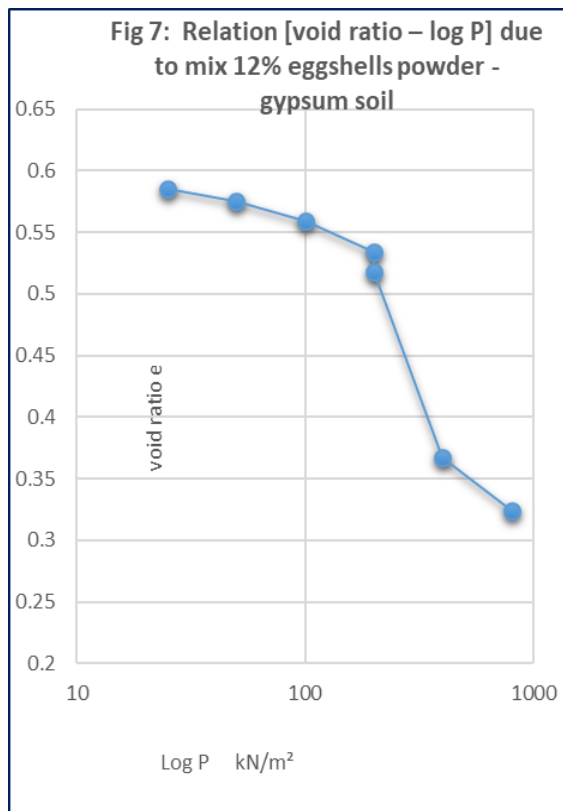
P kN/ m <sup>2</sup>	Soil gypsum		With mix 4%eggshells powder		With mix 8%eggshells powder		With mix 12%eggshells powder		With mix 16%eggshells powder		With mix 24%eggshells powder	
	Settl. $\Delta H$ mm	$\Delta e=F^*$ $\Delta H$ mm	Settl. $\Delta H$ mm	$\Delta e=F^*$ $\Delta H$ mm	Settl. $\Delta H$ mm	$\Delta e=F^*$ $\Delta H$ mm	Settl. $\Delta H$ mm	$\Delta e=F^*$ $\Delta H$ mm	Settl. $\Delta H$ mm	$\Delta e=F^*$ $\Delta H$ mm	Settl. $\Delta H$ mm	$\Delta e=F^*$ $\Delta H$ mm
25	0.49	0.040	0.345	0.028	0.2	0.016	0.53	0.043	0.49	0.040	0.23	0.019
50	0.6	0.049	0.445	0.036	0.29	0.024	0.755	0.061	0.61	0.050	0.42	0.034
100	0.79	0.064	0.59	0.048	0.4	0.033	1.01	0.082	0.81	0.066	0.61	0.050
200	0.95	0.077	0.77	0.063	0.58	0.047	1.41	0.115	1.12	0.091	0.8	0.065
200	3.53	0.287	2.02	0.164	1.59	0.129	2	0.163	1.32	0.107	0.91	0.074
400	3.63	0.295	2.24	0.182	1.85	0.150	3.195	0.260	3.17	0.258	1.51	0.123
800	4	0.325	2.66	0.216	2.23	0.181	3.815	0.310	3.7	0.301	2.1	0.171

Note : where  $F=1+e_o/H_o$ ,  $H_o=20$  mm,  $e_o=0.625$  mm

**Table 4.** type of collapse for all The percentage % eggshells powder

The percentage % (mix eggshells powder with the soil gypsum )	The value collapse CP $CP\% = \frac{\Delta H}{H_o} \times 100 = \frac{\Delta e}{1+e_o} \times 100$	Type collapse
0 %	12.9	Severe trouble
4%	6.2	Trouble
8%	5.04	Moderate trouble
12%	2.8	Moderate trouble
16%	0.98	No problem
24%	0.55	No problem





## 6. Conclusions

From results of all the tests done, it can be obtained that the better result of chemical soil stabilization of the gypsums by mixing the eggshells powder with soil gypsum that 16% eggshells powder. that it is the best percentage for improving the Properties of the stabilized soil than these percentages because the type collapse for this percentage is to be (no problem).

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