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BIO-VEGE GROUTING TECHNIQUE FOR LIQUIEFIED SOIL

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ABSTRACT

To improve the soil properties which is susceptible to liquefaction the traditional grouting methods can be suggested.But recently in 2013,the best suited and economic environment friendly method was introduced to overcome the liquefaction of soil.The method is known as Bio-vege grouting method.Lab tests can be carried out before using this method on soil,which is susceptible to liquefaction. Step to improve the mechanical properties of liquefied soil is to inject bio-vege grout into the soil sample.Soil sample can be prepared with three different grout amount 10%,25%,and 50%.The relation between percentage of bio-vege grout injected and soil improvement is to be observed and recorded.The void ratio and the permeability of soil sample decreased with increasing grout percentage.The soil becomes stiffer as the amount of grout used increase.In case study the results obtained indicate higher amount of grout injection reflects better soil improvements in terms of cohesion,friction angle,shear stress and void ratio.The bio-vege grout increases the resistance of soil against liquefaction.

***Keywords: Bio-vege grouting, Grouting,Liquefaction,Liquefied soil,soil properties*.**

I. INTRODUCTION

Soil liquefaction is the process in which soil goes sudden massive loading which eventually forces the soil to flow. This phenomenon will lead to instability of soil and causes serious damage to human life as well as properties. Liquefaction occurs when saturated cohesion less soil under oscillatory motion during earth –quake loses all its sheer strength due to pore water pressure and flows like a liquid.

The traditional methods to improve the soil properties to overcome liquefaction are soil improvement by mixing additives, stabilizing agents, grouting etc. A lot of research have been conducted , to develop sustainable or green material as well as the methodology in hope of reducing the carbon contents.

In last 10 years, many researches were conducted to introduce bio grout method for soil improvement.VAN PAASSEN, in 2009 proved that the bacteria can be used as a source to carbonate precipitation, which changes mechanical properties of soil. According to this research mixture of common bacteria, calcium chloride and urea to transform sand into sand stone using microbial induced carbonate precipitation (MICP) technique.

Very recently in 2012 a new technique of soil improvement was successfully introduced by H. Kamaruddin known as BIO-VEGE GROUT.

In this process, bacteria to form carbon precipitation could also be derived from vegetable waste also known as Vege grout.This modern technique proved to be economical, and amazing. This technique also can solve the big

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problem of disposal of vegetable waste. Vege Grout has significant impact on the properties of remoulded soil sample.

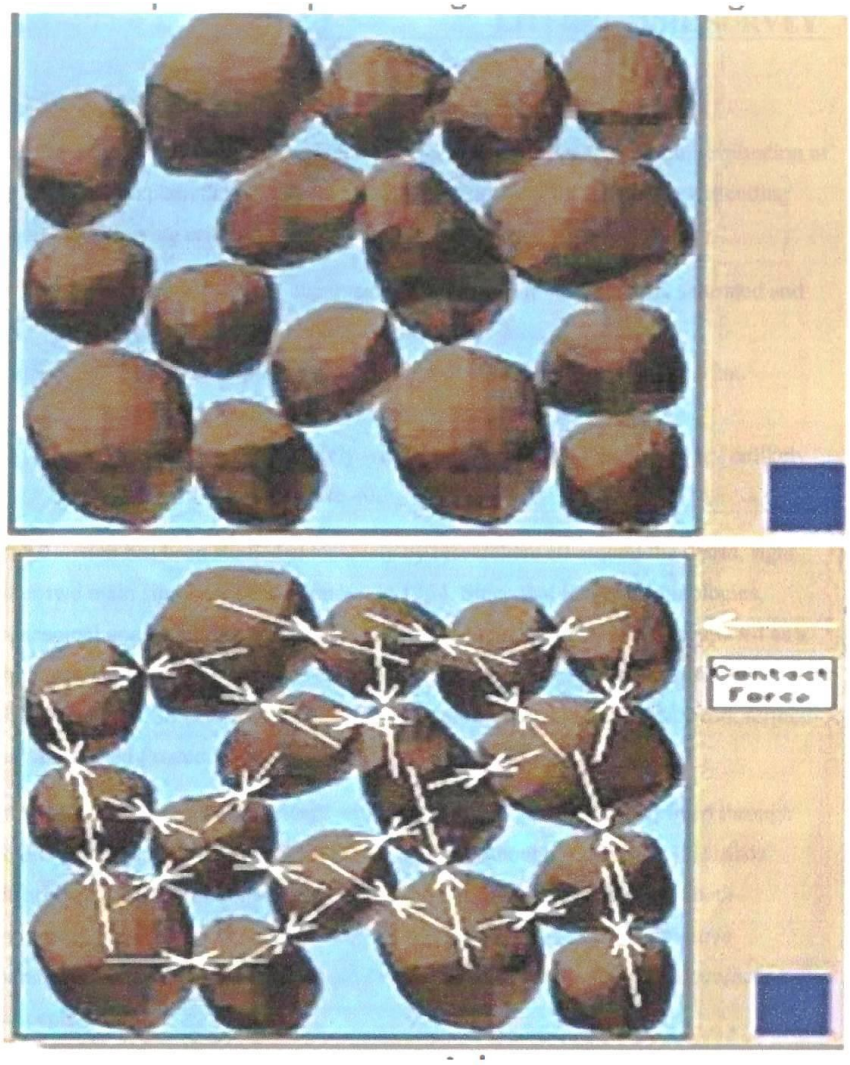

Image 1 – Liquefaction Process

II. SOIL MODIFICATION

2.1Bio-Mediated soil Improvement

The Bio-vege Grout contains microorganism which precipitate the calcite or calcium carbonate ($CaCO_3$) around each and every particle of the soil by going through some chemical reactions.Thus this method is economical and at the same time has low impact on environment.Bacteria and fungi are most commonly found in the waste as the waste starts to decompose.This formation of calcite on the grain will increase the stiffness and the cohesiveness among particles.Thin layer of calcite will form on the particle and the gap and voids between the particles which water can fill during earthquake leading to liquefaction . Indirectly the strength of the soil will increase to withstand the loading.

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III. METHODOLOGY

3.1 Soil sampling and preparation:

Soil samples are taken from site to be treated. According to the site investigation report, these soils must be susceptible to liquefaction phenomenon which has SPT value N less than 10. Means, SPT value N=10 are the soils which are susceptible to liquefaction. Both disturbed and un-disturbed samples are taken from laboratory testing. All soils are tested to obtain their index and mechanical properties like cohesion, sieve analysis, coefficient of permeability, initial void ratio. Etc.

3.2 Preparation of bio-vege grout:

Four types of vegetable wastes namely water spinach, cucumber, spinach and long beans to be collected to produce five different bio-vege grout. These vegetable waste with mass of 5 kg each to be stored in 5 different air tight containers for four weeks. As a result five different veg gout liquids i.e. spinach, long beans, water spinach, cucumber and mix vegetables to be produced. It is important to ensure that the liquid produced from the vegetable waste is free from any impurities and dirt, therefore it is required to filter the liquid before applying it to the soil.

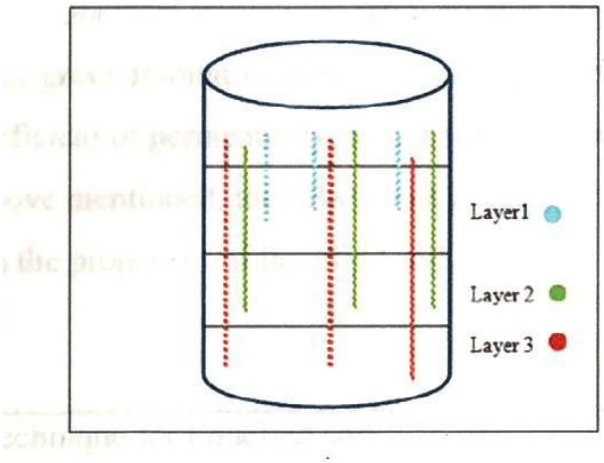

Figure 1. Schematic diagram of test sample

3.3 Application of bio vege grout onto the soil:

To study the performance of Bio Vege grout on soils, three samples weighing 200 grams with different amount i.e. 10 %, 25 % and 50 % of Bio Vege Grout to be injected and incubated for 4 weeks. The percentage of Bio Vege Grout used to be calculated based on the mass of soil used. To ensure the bio vege grout is spreading equally throughout the soil layers, the soils must be split into three layers with 6 cms in depth and bio vege grout liquid to be equally injected though 1.5 cms spacing drinking straw that penetrate the soil layers. The test sample set up as per Fig 1

3.4 Index and engineering properties:

A series of laboratory testing to be conducted in determining the index and engineering properties of the soil. The tests consist of initial moisture content, Sieve analysis, shear strength namely Unconsolidated Undrained triaxial testing,Consolidation and Permeability tests. A series of testing to be obtained before and after treatment with Bio Vege grout were recorded.

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3.5 Result analysis:

From the laboratory testing result, analysis is to be done. If the results are satisfactory in case of permeability, cohesion, initial void ratio, friction angle means when the percentage of Bio vege grout amount is increasing cohesion, friction angle should also be increased and coefficient of permeability, initial void ratio should be decreased. If the results are like above mentioned, then Bio Vege grout injection treatment can be suggested to improved the properties of liquefied soil.

IV. CASE STUDY

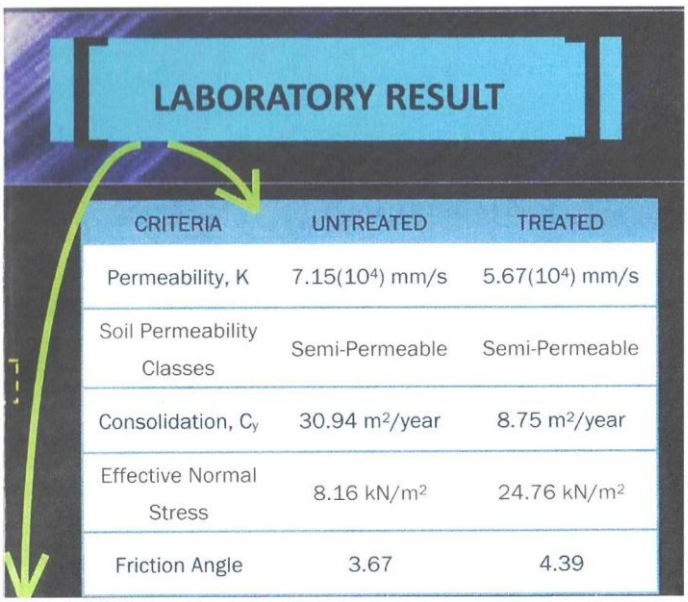
4.1 The first step in development of bio vege grouting :

In 2013 the college of engineering Uniten in Malaysia has a team of six members that develop this process. Before applying this process on the sloped surface they tested the soil samples before and after injecting the bio vege grouts for mechanical properties of soil and the results found were satisfactory.

The team members used fermented vegetable wastes injected into soil on sloped surfaces to help stabilize the soil. The soil becomes stabilized by turning into something that resembles cement. The anaerobic bacteria in the fermented vegetable matter works to bond the soil matter together creating a material that is less permeable, has greater consolidation, can withstand greater street load and can be used on steeper friction angles. Vegetable wastes were fomented to produce facilitative anaerobic, micro aerophylic bacteria i.e Anaerobic fermenting bacteria. The scientists used cabbage, cucumber, long beans, spinach and water spinach. The vegetable waste was blended and the sealed in a container for 30 days so that anaerobic bacteria takes over the mixture. After 30 days the mixture was placed on the soil and it is kept underground to harden for another 30 days.

4.2 Laboratory Results for the Process

4.2 LABORATORY RESULTS FOR THE PROCESS



CRITERIA	UNTREATED	TREATED
Permeability, K	7.15(10⁴) mm/s	5.67(10⁴) mm/s
Soil Permeability Classes	Semi-Permeable	Semi-Permeable
Consolidation, C_v	30.94 m²/year	8.75 m²/year
Effective Normal Stress	8.16 kN/m²	24.76 kN/m²
Friction Angle	3.67	4.39

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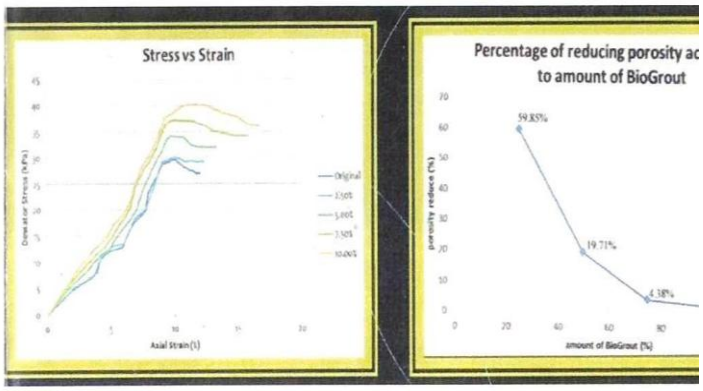
4.2.1 **Laboratory Results**

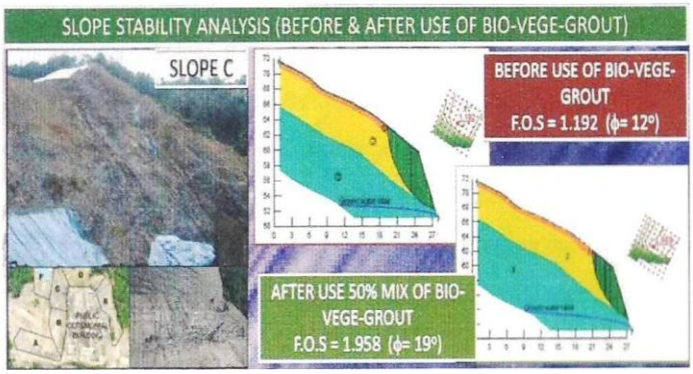
Table 1. Summary of engineering properties of soil using Bio-VegeGrout

PARAMETER	**Amount of Bio-VegeGrout (%)**			
	0%	**10%**	**25%**	**50%**
Cohesion,c (kN/m^2)	15	38	53	61
Friction angle, $\omega(^0)$	26	28	31	38
Coefficient of Permeability, k (m/s)	$3.36x10^{-6}$	$1.1x10^{-6}$	$5.7x10^{-6}$	$2.99x10^{-6}$
InitialVoid ratio	0.33	0.3	0.26	0.19

4.2.2 laboratory results



4.2 Stress vs Strain Graph



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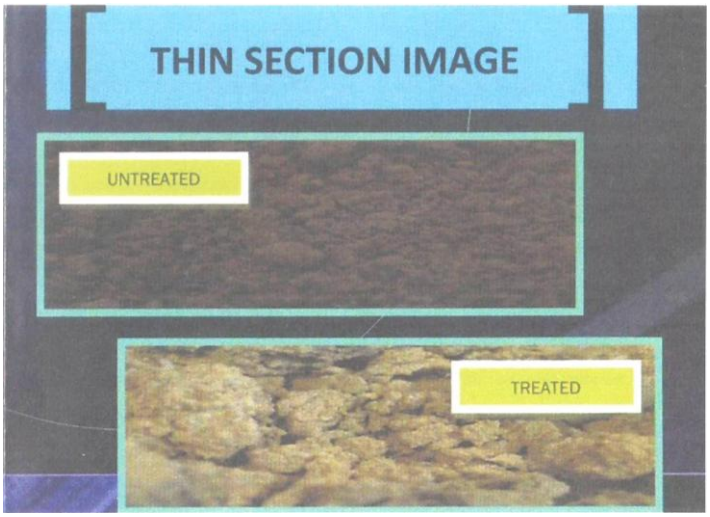

From the graphs and observation tables it is clear that the injection of bio vege grout has increased the shear stress of soil. The amount of grout used reflects the concentration of bacteria presence thus more bacteria can produce a higher amount of calcium carbonate precipitation. With the addition of 50 % grout the soil is able to withstand twice the load of the actual soil can support. Other engineering properties such as permeability and consolidation value are increased. The result shows that the permeability value of soil K. reduce as the percentage of bio vege grout increase. This is due to process of calcite precipitation which reduce the drainage condition of soil. Thus bio vege grouting may prove to be helpful to reduce the amount of soil settlement for building construction. To avoid landslides which are triggered by high level of ground water.

V. CONCLUSION

From the thorough study of process of bio vege grout it is clear that bio vege grout contains microorganism's which precipitate the calcite or calcium carbonate (Caco3) around each and every particle of the soil by going through some chemical reactions. Thus this method is economical and at the same time has low impact on the environment. Bacteria and fungi are most commonly found in the waste as the waste starts to decompose. This formation of calcite on the grain will increase the stiffness and cohesiveness among particles. This method may prove economical and also solve the problem of disposal of vegetable waste. Thin layer of calcite will from on the particle and the gap and voids between the particles which water can fill during earthquake leading to liquefaction. Indirectly the strength of the soil will increase to withstand the loading.

Future scope: As this process of grouting is in the initial stage at the time of laboratory testing it may include perform scanning electron microscope test (SEM) and X ray Diffraction tests (XRD) as well as to monitor PH and temperature during curing period for future work.

REFERENCES

[1] "Improvement of Engineering Properties of liquefied soil using bio-veg grout"- ICEE-13 By INZ Baharudding, R.C. Omar, Y. Devrajan

[2] "Bio grout based on microbially induced sand solidification by means of Asparaginose Activity" _ Researchgate.net.2015 By Meng Meng Li, Qing Long fu, Qiuzhuo, Vavenyam Achal, Satoru Kawasaki.

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ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

[3] "Evaluation of liquefaction potential of soil" in Indian journal of Applied research by Dr. R.P.Rethaliya, Kannan Thakkor.

[4] "Use of Grouting method to improve soil stability against liquefaction" in EJGE volume 17 (2/2) By Sanaz Sayehrand and Behzad Kalantari.

[5] "Soil Improvement by mixing techniques and performances" –www.sciencedirect.com by Oana Carasca.