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RESEARCH ARTICLE

SOIL STABILISATION USING LIME AND ELEPHANT DUNG BIO-STRIPS.

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Abstract

This paper presents a study on improving soil properties by using lime and elephant dung strips. Elephant dung strips produced by drying and extraction of elephant dung was added as a replacement to lime. Results have shown that elephant dung strips added to soil considerably increased its strength and elephant dung strips can be used as an effective material to replace a major portion of lime in the soil stabilization process. Tests conducted using elephant dung strips alone also showed a significant improvement in strength when the bio-strips were used upto 4%. Replacement of more than half the quantity of lime by elephant dung strips can be effectively implemented in stabilizing soil for practical purposes.

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Introduction:-

As a result of industrialization, development of infrastructure etc, a very good portion of the land area is used up, leaving behind only very few areas of land where construction is suitable. With increasing demand for land as far as construction activities are considered, we are forced to construct structures on soft soils which are not suitable for construction. Soft soils have very low bearing capacity and construction of structures over soft soils leads to excessive settlements. Construction of pile foundations is not always an economically feasible solution and most of the structures except heavy weight structures can be built on soft soils after stabilizing or improving the soil. A number of materials have been tried by various researchers all over the world to improve soil. The most commonly used stabilizers are lime, fly ash etc. Lime is commonly used due to its quick action and effectiveness in improving soil properties. However, stabilization of soil using lime is proving to be expensive nowadays and hence attempts are made to replace a portion of the lime with waste materials so as to make the overall stabilization process cost effective. In this study, elephant dung, a pure waste material is used to replace lime in stabilizing the soil. Elephant dung is dried and made into strips and these strips were added to soil for the stabilization process.

Materials:-

The materials used in this study include clay, lime and elephant dung. Locally available clayey soil collected from Chathanoor area in Kerala is used in this study. Lime powder available from the local markets was purchased and used in this study. Elephant Dung was collected from Puthenkulam and this was processed to obtain bio-strips.

Extraction of bio-strips from elephant dung:-

Elephant dung was mixed with a pool of water and then mixed thoroughly. Bio strips are separated by pulling with hand and then it is dried for 24 hours. The thickness of the bio strips thus obtained varied from 0.2 to 0.4mm and

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these bio strips were cut into a length of around 3 to 5cm. The high lignin content in elephant dung contributes to higher flexibility, durability and slow biodegradation compared to other natural materials. When dried, these strips act like fibres and thus prove to be an effective material which can be used to stabilize soil. The bio-strips used for this study is shown in the Fig 1.



Fig 1:- Elephant dung bio-strips

Tests Conducted:-

The various tests conducted to ascertain the effectiveness of bio strips as a soil stabilizer include optimum lime content test, compaction, atterberg limits and unconfined compressive strength. Optimum lime content to be added to soil was determined by measuring the pH of lime soil mix as per ASTM D6276 standards. The lowest lime content which gave a pH of 12.4 or above was taken as the optimum lime content. In this study, the optimum lime content was obtained as 4% of the weight of dry soil. All the other tests were conducted as per the IS 2720 standards

Soil Mixes:-

Tests were conducted on untreated soil as well as modified soil mixes. Mixes were modified by replacing 4% of the soil with lime, elephant dung etc. The various soil mixes used for testing were designated as shown in table I

Table I:- Soil Mixes used for study.

Sl No	Mix Designation	Details
1	C	Untreated Clayey soil
2	C + 4L	Clay with 4% weight replaced by lime
3	C + 3.5L + 0.5 ED	Clay with 3.5% lime replacement and 0.5% elephant dung replacement
4	C + 3L + 1 ED	Clay with 3% lime replacement and 1% elephant dung replacement
5	C + 2.5L + 1.5 ED	Clay with 2.5% lime replacement and 1.5% elephant dung replacement
6	C + 2L + 2 ED	Clay with 2% lime replacement and 2% elephant dung replacement

All the modified mixes contained same replacement amount equal to 4% of the weight of soil (optimum lime content value). Within that replacement amount, lime and Elephant dung proportions were varied keeping the total weight of replaced materials a constant.

Results and Discussions:-

The various mixes as described above were tested and the results of tests obtained are summarized in table II. Untreated soil was found to have an unconfined compressive strength of only 0.45 kg/cm². When optimum lime content was introduced into this soil, the strength of soil almost doubled and reached 0.88 kg/cm². In order to make the stabilization process cost effective, elephant dung strips were added in dosages 0.5%, 1%, 1.5%, 2% of weight of soil keeping total replacement equal to optimum lime content. The results of the various tests conducted on untreated and modified soil mixes are shown in table II.

Table II:- Test results on untreated and modified soil sample

Sample	Liquid limit	Plastic limit	OMC (%)	Dry density (g/cc)	Mean UCC (kg/cm ²)
Untreated soil	24	11	18	1.76	0.45
Clay + 4% lime	30	12.41	20	1.8	0.88
C+3.5L+0.5ED	34	11.5	22	1.810	0.712
C+3L+1ED	32	11.31	20	1.832	0.799
C+2.5L+1.5ED	31	12.88	22	1.845	0.862
C+2L+2ED	31	12.89	20	1.880	0.999

The results of compaction test carried out on elephant dung and lime modified mixes show that there is a significant improvement in the dry density of soil where as optimum moisture content was not found to vary much with the addition of Elephant dung. The increase in maximum dry density makes it a good material which can be effectively used in soil stabilization. The variation of dry density with the addition of elephant dung strips to soil is shown in figure 2.

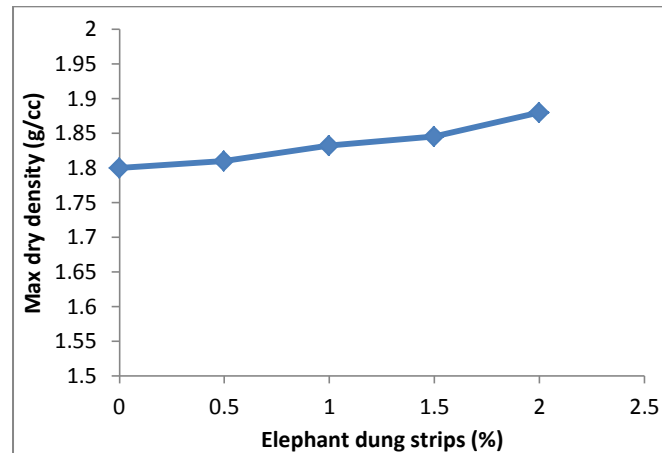


Fig 2:- Variation of dry density of soil mix with elephant dung content

Atterberg limits were not found to vary much on the addition of elephant dung strips which clearly depicts that the consistency of the mix is not affected as a result of introduction of elephant dung strips. The variation of atterberg limits with addition of elephant dung strips is shown in Fig 3.

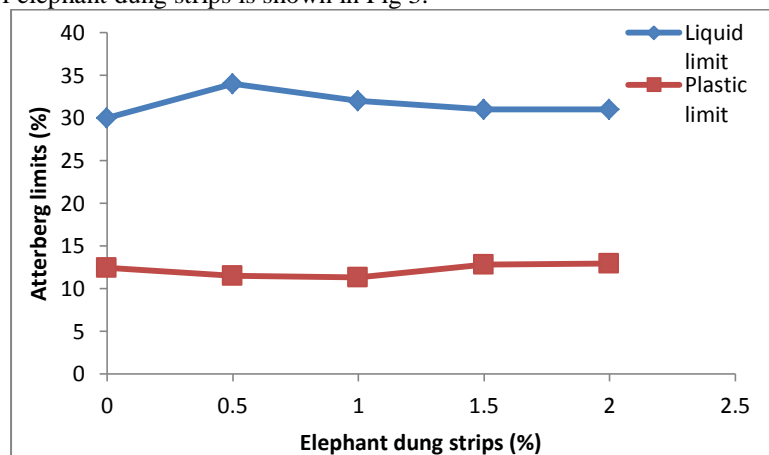


Fig 3:- Variation of atterberg limits with Elephant dung content.

Now considering the strength characteristics, it can be seen that there is a considerable increase in the unconfined compressive strength of elephant dung modified mixes. The fibrous nature of the elephant dung strips help in increased resistance under loads, prevent internal crack propagations and also improves the frictional and interlocking properties of soil contributing to increased shear strength. The unconfined compressive strength of soil mix containing 2% Elephant dung yielded a much higher value when compared to soil mix with optimum lime content. All replacements of elephant dung showed higher values of strength than that of untreated soil. These results prove that Elephant Dung can be used as better stabiliser for soft soil and it can effectively replace lime to give better properties. The variation of strength of lime and elephant dung modified soil mixes is shown in Fig 4.

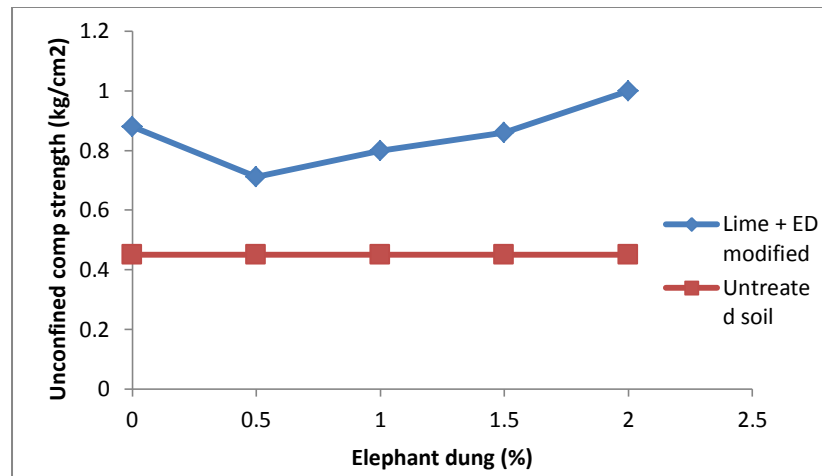


Fig 4:- Variation of strength of lime modified mixes with bio-strip.

As the addition of elephant dung to soil improves the shear strength to a great extent, tests were conducted avoiding lime and replacing the soil with only elephant dung strips. Elephant dung strips were added at increments of 1% to the soil mix. The variation of unconfined compressive strength of soil with addition of elephant dung strips is shown in figure 5. From the figure, it can be seen that, there is an increase in the unconfined compressive strength of soil mix on the addition of elephant dung strips. It was observed that an increase in elephant dung strip quantity by more than 4% of the weight of soil decreased the unconfined compressive strength of soil. This can be attributed to the fact that the comparatively weightless elephant dung strips constitute a large volume in the mix when replaced by 4% of weight of soil and above, thus contributing to a decline in strength. However the elephant dung fibres can be effectively used upto 4% to get better soil properties. 4% of elephant dung strips increased the strength of soil mix to more than double when compared to that of untreated soil and almost 1.25 times the strength when compared to soil with optimum lime. On the whole elephant dung strips can be effectively used for improving the soil properties

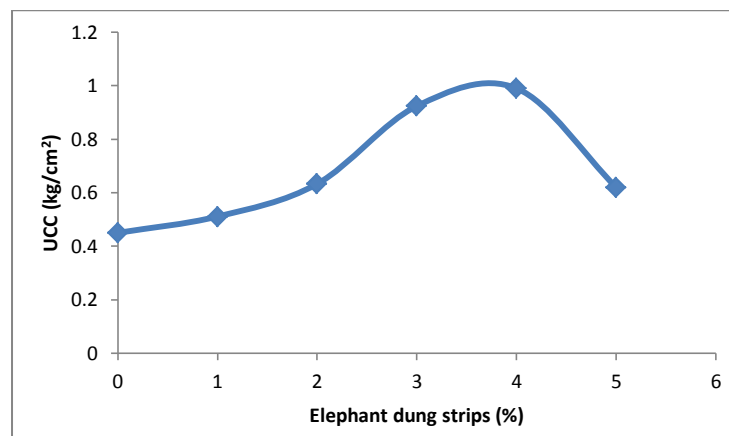


Fig 5:-Variation of strength with bio-strip content for mixes without lime

Conclusion:-

The study revealed that elephant dung strips can be effectively used to improve soil properties. Usage of elephant dung strips upto 4% of weight of soil was found to significantly increase the strength. Being a natural biological material, the use of elephant dung strips alone to soil may arise questions about its durability. But this can resist the higher loads coming during the initial stages of construction thus avoiding severe damages and consolidation settlements. To avoid any doubts of durability, this elephant dung strips can be used in conjunction with lime and this can replace almost half of the lime used for stabilization to give better strength properties at reduced cost. Replacing almost 75% of the lime with Elephant dung strips will also give strength much greater than that of untreated soil. Thus it can be said that elephant dung strips are an economic way to stabilize soil which gives better properties and making the process environmental friendly.

References:-

1. Adams Joe, Maria Rajesh “Soil Stabilization using industrial waste and lime, International Journal of Scientific Research Engineering & Technology, Volume 4, Issue 7, July 2015
2. Bowles, J E, Physical and geotechnical properties of soils, 1979
3. F G Bell, “Lime stabilization of clay minerals and soils, Journal of Engineering Geology, Volume 42, Issue 4, July 1996, pp 223-237
4. Prasanth S et al. “Effect of Rice husk Ash on the Engineering properties of silty clay”, International Journal of Scientific and Engineering Research, Volume 7, Issue 4, April 2016, pp 178-180
5. Theivarsu, C. And Chandra S, “Adsorption performance of activated carbon prepared from elephant dung for the removal of Reactive yellow from aqueous solution”, Journal of desalination and water treatment, volume 51, issue 40-42, 2013