International Journal of Research in Engineering, Science and Management
Volume-3, Issue-2, February-2020
www.ijresm.com | ISSN (Online): 2581-5792

Influence of Fly Ash On Sepiolite

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***Abstract*: The soil strength and its characteristics can be improved by mixing it with additives. Sepiolite is a naturally occurring clay mineral. Fly ash is a most commonly produced industrial waste product. The fly ash is mixed with sepiolite at various percentages and properties such as specific gravity, pH, Atterberg limits, compaction characteristics, UCC, and permeability are studied. The fly ash is added to the sepiolite with 2%, 4% and 6% and the variation of properties are found out. The improvement in the soil properties are reported with fly ash content. consistency limits were decreased with the increase of additive content. The compaction curve moved towards left with addition of fly ash. 7-day UCC strength is improved by 48% of initial UCC strength.**

***Keywords*: Sepiolite, Fly ash.**

1. Introduction

In recent years, the lack of availability of natural clays with satisfactory engineering properties has prompted researchers to look for alternative approaches for engineering purposes. The geotechnical engineering has a great role in engineering. The soil strength and its characteristics are improved by mixing it with various products. The various external substances added to the soil is generally named as additive. The additive is generally added to improve soil properties. The generally soil is improved for better strength and hydraulic property. The strength property is improved for the sub base, embankment and filling purposes. The hydraulic properties are investigated for the embankment, liner properties. The sepiolite is a clay mineral which is also called meta montmorillonite because of its swelling property. Fly ash is a most abundantly seen industrial waste product.

2. Materials Used

Sepiolite: Sepiolite belongs to the phyllosilicate group of clay minerals with a 2:1 ribbon structure. It is composed of continuous and two-dimensional tetrahedral layer composition and discontinuous octahedral layers. Octahedral layer discontinuity leads to the formation of internal channels in the structure, which provides high absorptive capacity.


Fig. 1. Sepiolite

Sepiolite collected for this study was from, Aastra Chemicals Pvt. Ltd. Chennai, shown in fig. 1. The chemical composition of the sepiolite used in this study is given in the table 1. The initial properties of sepiolite is given in table 2.

Table 1
Chemical Composition of Sepiolite

Contents	Max.	Min.
Silica, SiO_2	56	58
Ferric Oxide, Fe_2O_3	-	0.25
Calcium Oxide, CaO	-	0.75
Magnesium Oxide, MgO	28	30
Loss on Ignition	7	8
pH of 5% Slurry	8	8.5

Table 2
Initial Properties of Sepiolite

S. No.	Property	Value
1	Colour	White
2	Specific gravity	2.95
3	Liquid limit (%)	58.5
4	Plastic limit (%)	19
5	Plasticity index (%)	19.5
6	Shrinkage limit (%)	12
7	IS classification	CH
8	OMC (%) (IS 2720(7))	32.3
9	MDD(KN/m^2)	15.07
10	% Clay	60
11	% Silt	40
12	% Sand	0
13	Activity	0.325
14	UCC Strength (KN/m^2)	120
15	Free swell index	0.8
16	Permeability (cm/s)	$6*10^{-8}$

Fly ash: Fly ash is a major industrial waste product which is produced by the burning of powdered coal or other material carried into the air with presence of oxygen. It is also known as flue ash. The fly ash collected for this study is collected from the industries of Tuticorin.

The composition of Class – F fly ash collected for this study is shown in table 3.

Table 3
Chemical composition of Class F

Compound	Fly ash class F
SiO_2	55
Al_2O_3	26
Fe_2O^3	7
CaO	9
MgO	2
SO^3	1

3. Methodology

Detailed experimental study is undertaken to investigate the characteristics and behavior change of sepiolite with the addition of fly ash in various proportions. Basic geotechnical laboratory testing was performed to establish the index properties of the clay mixture. Basic geotechnical properties test such as specific gravity, grain size distributions, swell tests, water content determination, Atterberg limits, UCC, pH and compaction tests were conducted to assess the behaviour of soil mixture. The fly ash content is mixed with the sepiolite in percentages of 2%, 4%, and 6 % by weight. The consistency properties of soil were determined for the soil fraction passing 425 µm sieve. Representative soil passing 20 mm IS sieve was used to obtain the dry density moisture content relationship by standard Proctor compaction test.

4. Result and Discussion

Specific Gravity: Specific gravity showed a negative trend with the addition of the fly ash to the sepiolite. The specific gravity value decreased with addition of fly ash.

pH: With addition of the fly ash the soil shows a positive trend in pH. The pH value increased with addition of fly ash.

Table 4
Variation of pH and G

Kaolinite (%)	0%	2%	4%	6%
G	2.95	2.9	2.86	2.8
pH	8.5	8.58	8.69	8.74

Consistency limits: The affinity towards water and the water holding is represented by this consistency limits. The consistency limits show a negative trend, which means the reduction of Atterberg limit with the addition of the percentage increase of fly ash in it. Fig. 2 shows variation of Atterberg limits with various percentages of fly ash with sepiolite.

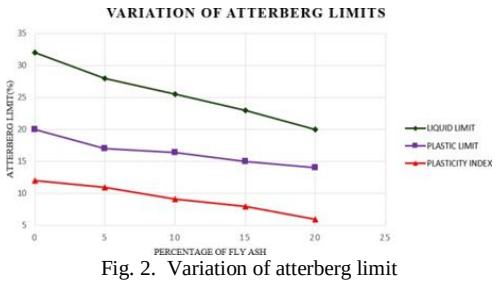

Fig. 2. Variation of atterberg limit

Compaction: The sepiolite is mixed with 2% of fly ash to 6% fly ash is subjected to the standard compaction. The optimum moisture content value decreases with the addition of the fly ash. Increase of fly ash content in the soil show lesser affinity towards water, this cause reduction in optimum moisture content.

Maximum dry density shows a very little or flat variation with the addition of fly ash in the soil. This is because the fly ash is non plastic in nature. The compaction curves of sepiolite and various percentages of fly ash is shown in fig. 3.

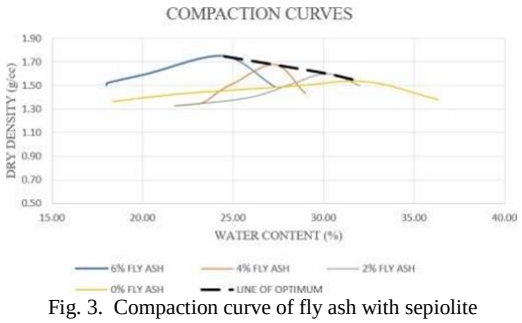

Fig. 3. Compaction curve of fly ash with sepiolite

UCC: The maximum value of strength obtained was for 4% of fly ash with addition with sepiolite is shown in fig 4. The 7th day compressive strength is tested after curing. The strength improved 1.48 times than the zeroth day.

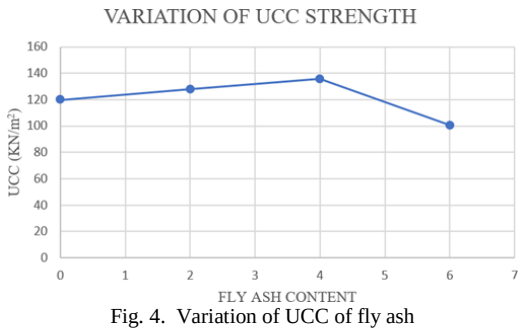

Fig. 4. Variation of UCC of fly ash

Permeability: it is major property of the soil, which gives an idea about the seepage through the soil. The permeability is improved upto 4% addition of fly ash, after that it shows a negative trend.

5. Conclusion

The sepiolite is mixed with varying percentages of fly ash. The fly ash is a non- plastic material which is collected from Tuticorin and kaolinite was collected from EICL Veli. The fly ash is mixed with a percentage variation of 0%, 2%, 4% and 6%. The physical and engineering properties of mixture is investigated. The variation gives an idea about the property and physical nature of the mixture is checked.

The addition of fly ash in the soil shows changes in the properties. The specific gravity and pH of the sepiolite is decreased with increase in the content of fly ash. The soil become more acidic. The soil shows a tendency from changing alkaline to acidic nature. The mechanical compaction test

results show a decrease in the optimum moisture content (OMC) and an increase in the maximum dry density (MDD). This results an uplift in the compaction curve from the initial compaction cure towards left. The reduction in the maximum dry density is due to the plastic nature of the fly ash. The consistency index shows decrease in trend. which represents less affinity to water with increase in the fly ash. The unconfined compressive strength of the clay is maximum at 4% of the fly ash content in the sepiolite. There was an increase in the permeability with increase in the fly ash content in the sepiolite.

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