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STABILIZATION OF FLY ASH BY USING LIME AND SODIUM SILICATE WITH SOIL SAMPLES

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Abstract: **The substantial challenge on behalf of engineers specifically civil engineers are the scraping of industrial waste output and their storage. Currently most of the industries to use the wastes in various areas like civil constructions, treatment of materials and others. To prevent the environment from the dangerous effect the scraps material should be uses again and again in the essential way to overcome from the wastes on environment. The only industrial scrap is Fly Ash which is produced throughout the country in every year. Fly ash is a dusty powder acquired from burning of coal through the production of electricity. Dumping of Fly ash is a big issue, to minimize the dumping of Fly ash into big area, it was habituated as a construction material in civil engineering works like building materials embankments, and bricks making etc. Presently, an experimental survey was carried out to find out the strengthening properties of Fly ash with lime and Sodium silicate. Particularly some parameters like grain size distribution, liquid limit, OMC, MDD, Specific gravity and angle of internal friction of Fly ash were find out and then Fly ash was mixed with various percentages of lime (0-15%) and sodium silicate (1-4%). All the different proportions were tested to acquire optimum percentage of lime and sodium silicate. The difference in shear parameters like cohesion and angle of shearing resistance were practiced by conducting direct shear test. All the tests were completed afterwards a time period of 3hours from starting to the completion of preparation of sample. Every test should be performed under the normal stresses of 0.5kg/cm2, 1kg/cm2, 1.5kg/cm2, 2kg/cm2 and 2.5 kg/cm2. The results are collected in a graphical manner to observe the trends for shear parameters. The conclusions show remarkable enhancement in strength characteristics for greater percentages of lime and sodium silicate.**

Keywords: **Coefficient of curvature, Optimum Moisture Content, Maximum Dry Density, Cohesion, Internal friction.**

I. INTRODUCTION

Fly Ash is a substantially inorganic as.hes get from the flue gasses of furnaces at pulverized coal power plants. The size of the large amount of particle percentage is smaller than 75µ. These elements consist primarily of silica, alumina and iron. In India, coal ash is produced about 70 million tones per year and from burning about of coal for electric power generation about 200 million tones per year. The handling of Coal-ash shows severe environment difficulties for India and requires a mission-mode approach. Thermal power plant requires costly land to dispose the wastage and the transport of Fly Ash to the ash ponds result heavy expense. Considerable research and development work have been undertaken throughout the country towards constructing building and developing appropriate technologies for discarding and exploit of Fly Ash in construction industries.

Now a days only 10% Ash is used in Ash dykes construction and land filling and only about 3% Ash is used in other construction industries. Large portion of fly ash approx 80% or more is used in developed countries for the frame of bricks, cellular concrete blocks, road construction, land fill application, ceramics, agriculture, insulating bricks, recovery of metals and dam constructions etc. Prevailing, for one metric tones of Ash discarding about one acre land is needed.

Use of Fly Ash in America is only about 30% of the Fly Ash produced according to the estimation reports of Malhotra and others in 2002. Two thirds concrete is used which has reached a maximum consumption figure. By pointing out that Israel would produce 1.3 mega tones of coal ash per annum by 2001 and that 0.6 mega tones could be used by the cement industry. Almost 50% of the Fly Ash produced is used in U.K where as only 6% Fly Ash is used out of the total production in India.

Highway engineers are utilizing mass abundance of Fly Ash in embankments and road constructions. Only during the construction period the Fly Ash lay down in very minute amount and not later. For high embankments low density is more fit. Fly Ash augmentation cementinious properties from lime stabilization due to the arrangement o silicate hydrates at the time of pozzulanic reaction. The strength of Fly Ash is exceed for the stable sub-grade or sub-base because of the lime stabilization, due to lots of cementing properties. As compared to lime or un-stabilized Fly Ash sub-grade the Cement stabilized Fly Ash has beat interpretation in load carrying volume and abatement of jack. The strength of Fly Ash can accelerate by mixing some additives such as sodium silicate.

II. METHODOLOGY

The index and engineering properties of the Fly Ash is determined by the following test:

1. Grain Size Analysis
2. Atterberg's Limits
3. Specific Gravity
4. Light Compaction
5. Direct Shear Test

III. RESULT AND DISCUSSION

Fly Ash was collected from GMR Power Plant in Raipur. The physical properties, Index and engineering properties of Fly Ash has been find out by the experimental research. The physical properties and chemical composition of Fly Ash are shown below.

Table No:3.0

Property	Values
Gravel (%)	0
Sand (%)	28
Fines (%)	72
a. Silt(%)	72
b. Clay(%)	0
Liquid Limit (%)	28
Plastic Limit (%)	NP
Specific gravity	2.1
IS Light Compaction	
Optimum moisture content (%)	30.0
Maximum dry density (g/cc)	1.28

3.1 Chemical composition of Fly Ash

Table No: 3.1

Compound Formula	Percentage
SiO2	55.85
Al2O3	24.98
CaO	2.54
MgO	1.14
TiO2	6.91
V2O5	0.15
ZnO	0.09

3.2 Grain Size Distribution

According to IS: 2720(part-IV) this test was conducted. According to IS: 2720 the sieve sizes are 4.75mm, 2.36mm, 1.18mm, 0.6mm, 0.425mm, 0.3mm, 0.15mm and 0.075mm.

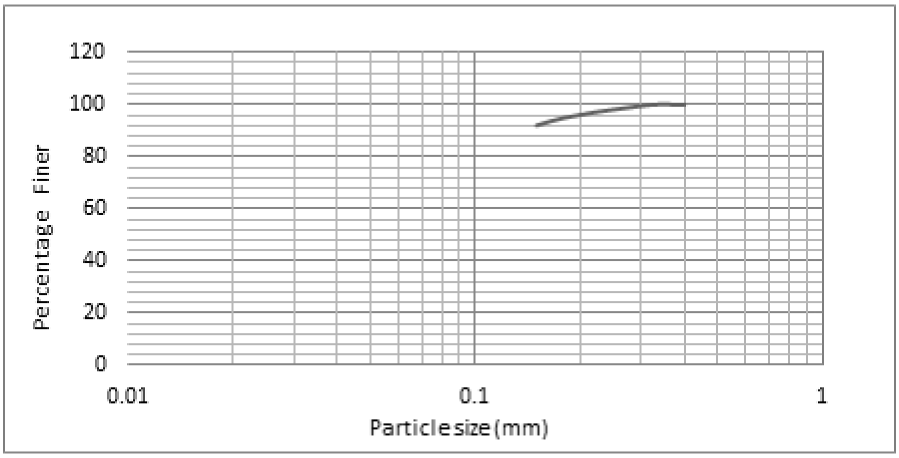

Fig: 3.1

Coefficient of uniformity: Cu = 28.89;

Coefficient of curvature: Cc = 2.13

3.3 Compaction Characteristics

3.3.1 Compaction Characteristics of Fly Ash Lime Mixes

As per IS: 2720 (part VII) – 1980 the Fly Ash tested for OMC and MDD with various percentages of lime and dry Fly Ash.

Table No: 3.3.1

LIME (%)	OMC (%)	MDD (g/cc)
0	30	1.28
2	31.4	1.26
4	31.8	1.24
6	34.3	1.23
8	36.4	1.21
10	37.3	1.18
12	38.2	1.16
15	38.3	1.14

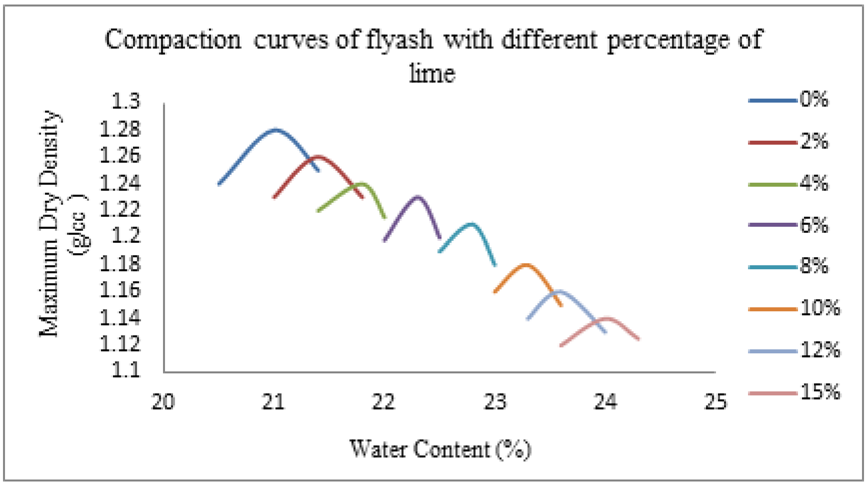

Fig: 3.3.1

The variation of maxmium dry density (MDD) and optimum moisture content (OMC) of Fly Ash-Lime mixes shows in table No: 3.3.1 and fig No: 3.3.1. The MDD de-escalate significantly with escalate amount of Lime (0-15%) from 1.28 g/cc to 1.14 g/cc, and OMC escalate with escalate amount of Lime (0-15%) from 30-38.3%. The amount of water is increases if the lime content is increases because of the hydration process amount of water is requried more that's why the value of OMC increases with increasing amount of lime content.

3.3.2 Variation in Ø Values for Different percentage additions of Lime

The interpretation in shear parameters was tested for Fly Ash samples at distinguishable percentages of water quantity. The samples were tested at Dry of optimum, OMC and Wet of Optimum conditions. The test was conducted under normal pressure of all water contents as 0.5kg/cm^2,1.0kg/cm^2 and 2.0kg/cm^2 respectively. After 3 hours of curing period each and every test was conducted. The samples were properly cured under cover so that the loss of water is inconsiderable.

Table No: 3.3.2

% OF LIME	OMC (-2)	OMC (-1)	OMC	OMC (+1)	OMC (+2)	OMC (+3)
0	25	28	30	29	26	24
2	27	30	31	30	28	26
4	29	31	32	31	30	27
6	30	32	34	33	31	29
8	31	33	36	34	32	30
10	32	35	37	35	34	31
12	32	35	38	36	34	31
15	32	36	38	37	34	31

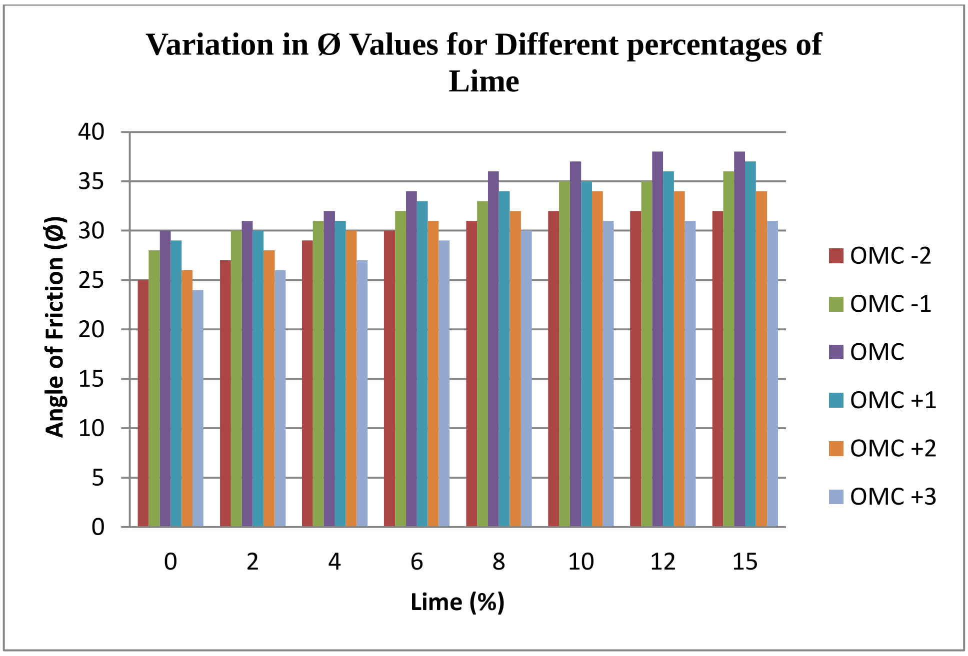

Fig No: 3.3.2

The friction of the particles is greater because the maximum values are obtained by mixing 15% of lime. The productivity is increases with the high percentage of lime when the flocculation is done in the mixes. The values of the friction are increased at OMC water content, farther the values decreased due to the high amount of water content which are responsible for the friction loss in between the particles. The amount of water are lesser in OMC than in Dry of Optimum conditions like OMC-2, OMC-1 because the water is not enough to form flocculated mixes in the structure.

3.3.2.1 Variation of Ø values with different water contents

The results observed in the shearing resistance values for different percentage of lime and for all water contents are shown below.

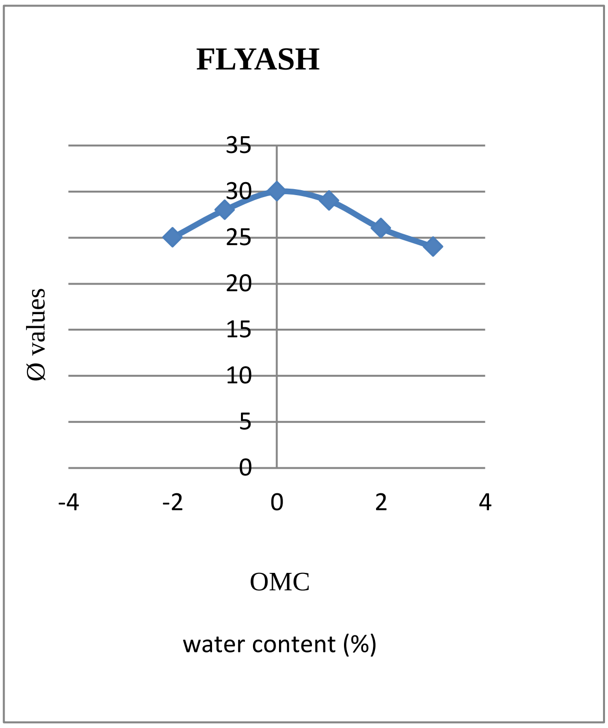

Fig No: 3.3.2.1(a)

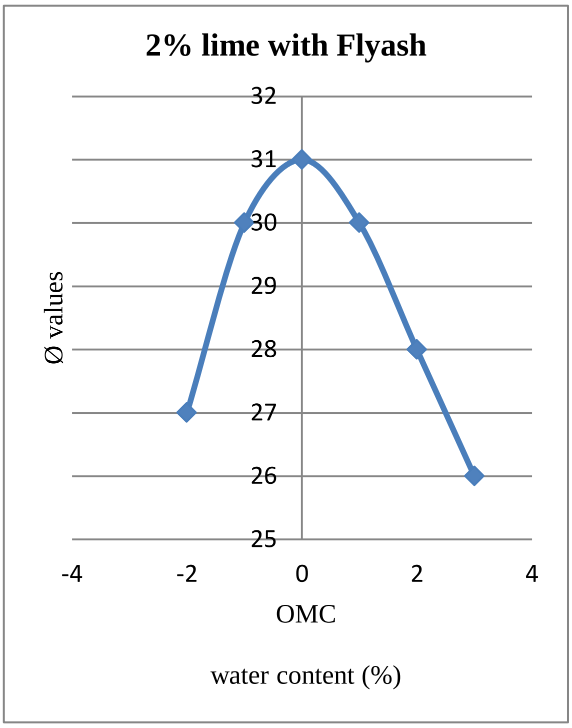

Fig No: 3.3.2.1(b)

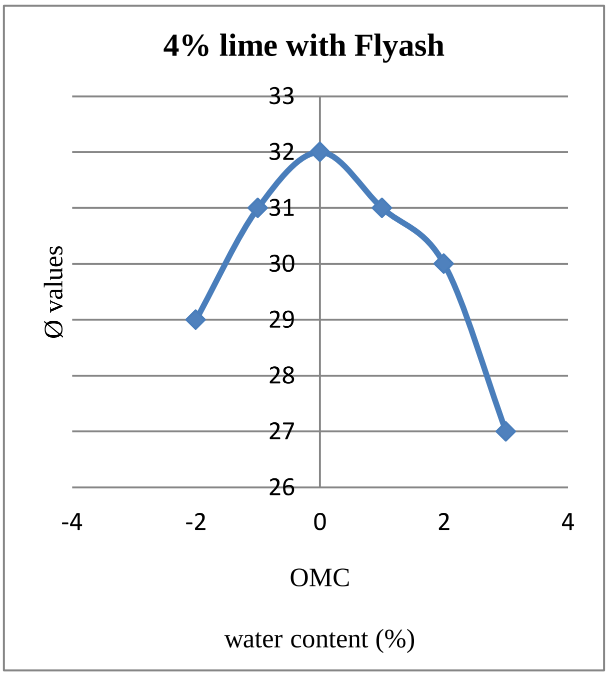

Fig No: 3.3.2.1(c)

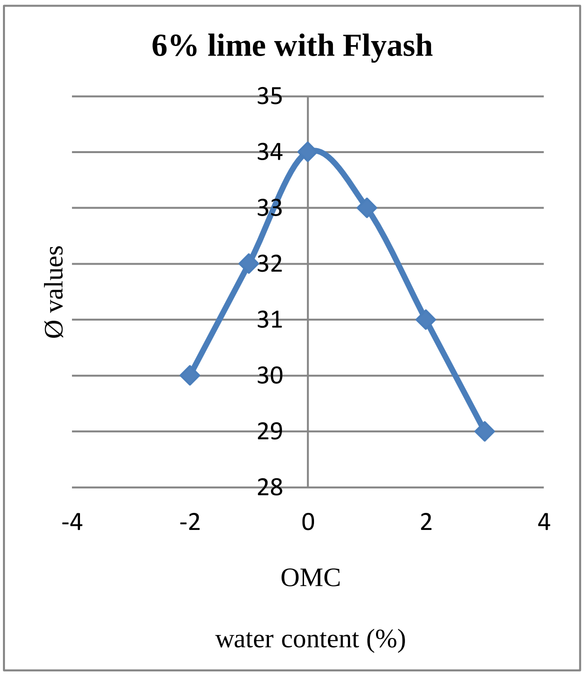

Fig No: 3.3.2.1(d)

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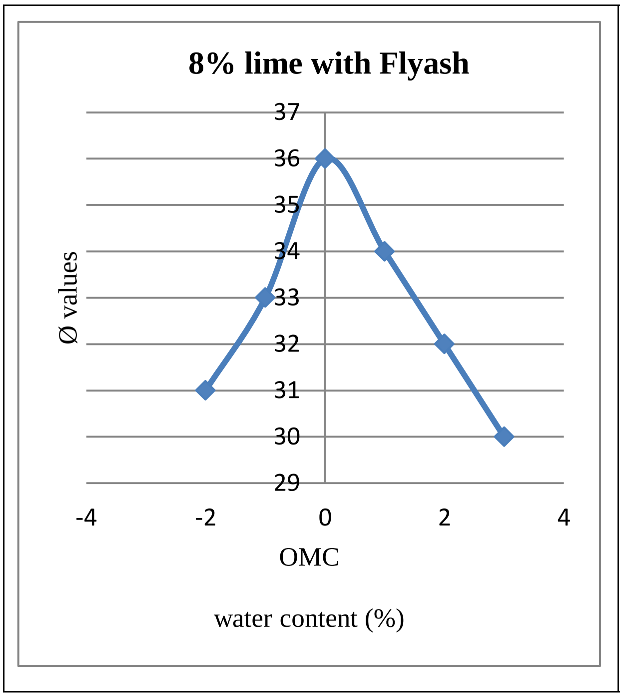

Fig No: 3.3.2.1(e)

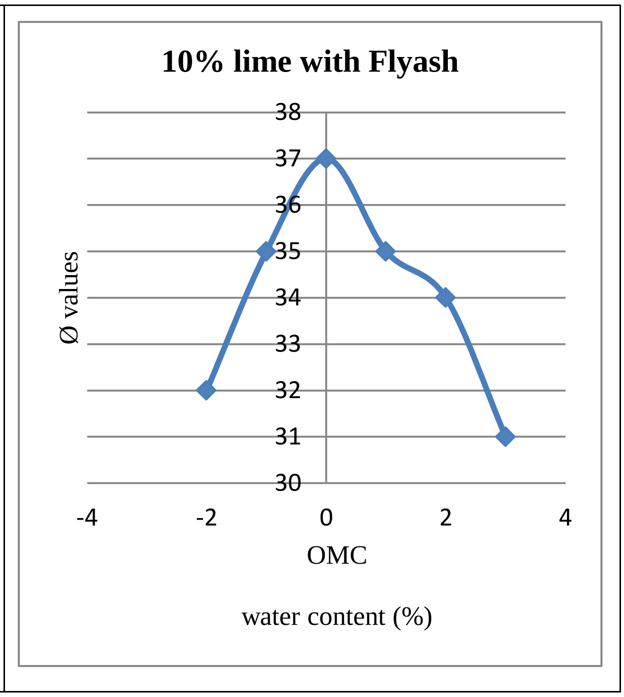

Fig No: 3.3.2.1(f)

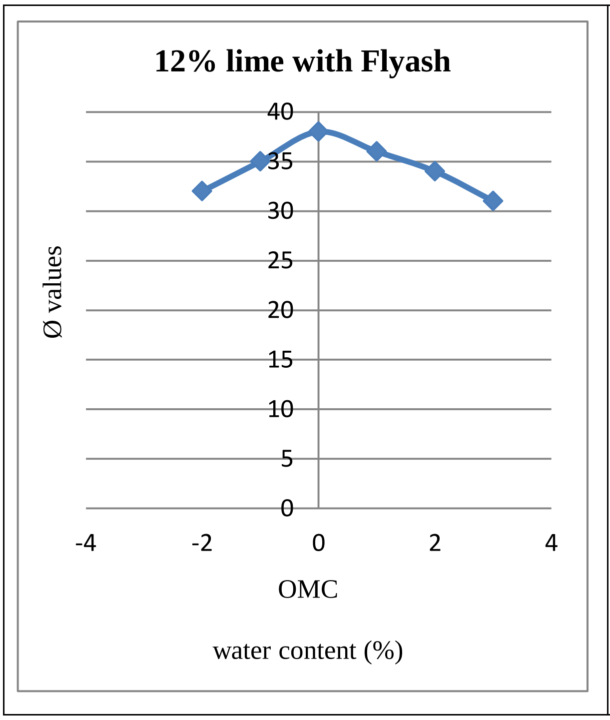

Fig No: 3.3.2.1(g)

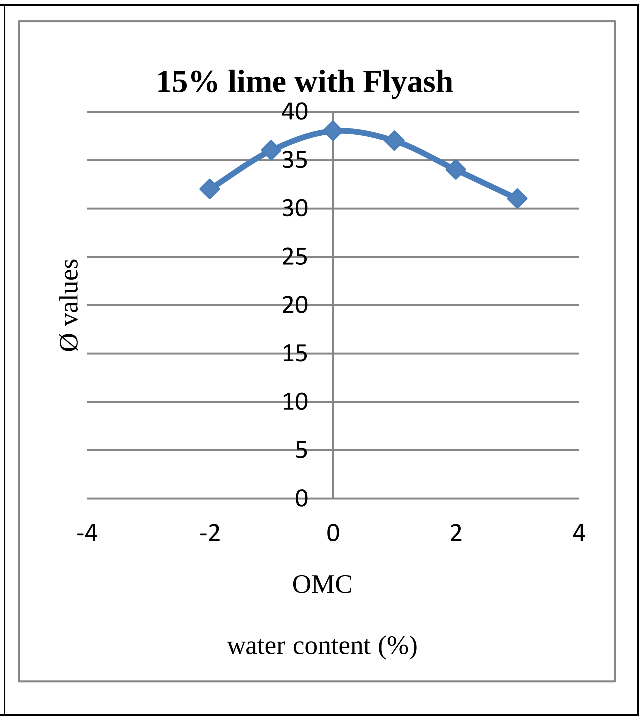

Fig No: 3.3.2.1(h)

The value of the shearing resistance is extended with the extend percentages of lime. The amount of calcium oxide is high if the lime content is increased because calcium oxide provides better resisting capacity of Fly Ash samples. The productive bonds are shown between the fly ash and lime particles so that the values are max at OMC. After OMC water content OMC (+1) have shown improved resistance against shear assimilate to other water contents like OMC (-1), OMC (-2), because of the functional participation of calcium oxides and aluminates present in the stabilized mixes. The water content is deescalate beyond OMC (+2) because further escalate in water content then the mix is scattered and weak. Due to the strong bond among the particles the OMC (-1) water content has provide improved results than OMC (-2) water content. This trend is almost equal for all percentage additions of lime. The values of the shearing resistance is totally proportional to the values of OMC and MDD, if the values of OMC and MDD are increased the shearing resistance are also increased and vice versa. According to the increased amount of percentages of lime the values are also increased it is not only depends on the increased amount of calcium oxide but also due to the flocculated structure obtained in the mix. Chains are formed in the mix due to the flocculation process in the structure and strong bond is resulted in the mix, due to this technique of mixing it helps to increase the strengths.

IV. CONCLUSION

From the study of Fly Ash stabilized with lime, cement and sodium silicate at compacted condition. The following conclusions have derived:

- The pozzolanic reaction developing between silica alumina with calcium formed calcium silicate gel. The maximum strength developed because gels are crystalline with time
- Flocculation has taken place because of additives like lime and sodium silicate with time.
- The maximum value of shearing resistance is shown by the addition of lime and sodium silicate of 15% and 4% respectively.
- Due to the dispersed structure the values are less in Dry of optimum and Wet of optimum both.
- Due to the insufficient amount of water flocculated structure is formed and at OMC-2 all the values are less for all percentages of lime and sodium silicate.
- At OMC the values are maximum for all proportions in which the effective flocculation occurs.

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