Improvement Of Index Properties Of Soil Using Industrial Waste (spent wash)

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Abstract- *Now-a-days, there is rapid and continual development in each and every business of expression industry. Roads are also plays heavy enactment in exercise of our nation growth.*

There are more methods and technologies which are effectively adoptive for soil stabilisation but over this the use of spent wash and fly ash is beneficial in outlay and the substance can be prefabricated easily accessible from sugarcane manufacture. These raw materials may cause a big impact on environment ,if these are get used in stabilization of soil then construction becomes eco-friendly.

To reduce the problems of industrial waste disposal, utilization of waste in large quantities in Geo-technical Engineering works is having important aspect. Keeping this view in mind the present study has been carried out to assess utilization of spent wash and fly ash for improving properties of sub-grade soil present below road pavement. Melanoidin present in the spent wash can act as a binder which can help in stabilizing soil

India is the largest consumer of sugar in the world with second largest producer next to Brazil. Hence experimental investigations have been made to study the suitability of spent wash (waste water from sugarcane factories) to improve some properties of soil. The important geotechnical properties tested are: 1. Specific gravity 2. Liquid limit 3. Plastic limit 4. Plasticity index 5. Dry density 6. Optimum moisture content.

Standard Proctor Tests are carried over various soil specimen with varying percentage of spent wash and fly ash (5, 5.5, 6, 6.5, 7.5%) and results are find out satisfactory.

These techniques are more effective and beneficial. Working on the same way, by using the improvement technique in the modification of construction of road pavement. The detail investigation of the work carried out, from the observations, and results obtained and discussed in detail. Based on the study optimum mixes are found out for Soil Mixes (SM).

The conclusions are drawn, based on the experimental investigations.

Keywords — Spent wash, Fly ash, Atterberg's consistencylimits, Soil Stabilization.

I. INTRODUCTION

Roads plays a vital component of transportation system by the means of getting agricultural crops to market and sustaining the lives of farmers. Hence, good road network is a key of development of any country. In India approximately 69,000 miles of these roads are stabilized with gravel or crushed limestone because their low traffic volume does not justify paving with asphalt or Portland cement concrete. With the increased global demand for energy and increasing local demand for aggregates it has become expensive from material cost point of view to remove inferior soils and replace them with foreign soil which can give better suitable. Hence, it becomes essential to modify the properties of locally available soil to the extent that it can be used in the construction of roads so as to minimize the cost of construction of roads and to make best utilization of various industrial by-products like, Spent wash and fly ash as a soil modifying, soil stabilizing agents.

Spent wash and fly ash are being produced in sufficient quantity in Maharashtra therefore there is no question of its availability. In this study it is intended to study various properties of spent wash and as soil substitution or as binding material especially in the construction of roads.

More recently, the high costs of waste disposal techniques have sparked an interest in the possible use of waste materials such as fly ash, steel slag, waste tires, lignin and spent wash etc. These materials may be added individually or in combination with soils in various geotechnical engineering works to reduce the quantum of waste required to be disposed off.

During last 35 years, the capacity of nations to produce consumes and discard waste has grown dramatically requiring innovative techniques of management of complicated and varying type of waste.

A. Spent Wash Used As Road Construction:-

Types Of Spent Wash:-

1) Cane Spent wash :-

Spent wash is pollution intensive waste water generated by distilleries its dark brown color is due to the recalcitrant melanoidin pigment. Distillery spent wash is perceived as one of the serious pollution problems of the countries producing alcohol from the fermentation and subsequent distillation of sugar cane molasses Spent wash is the most valuable by-product from the Sugar Industry. The spent wash referred to in this article is blackstrap spent wash, which is the spent wash from the production of raw sugar from Sugar cane. In this study spent wash was obtained from Someshwar Sahakari Sakhar Karkhana, At.Post.Someshwarnagar, Dist. Pune. Maharashtra, India

B. METHODS:-

1) Laboratory studies

a) Sample Preparation and Testing Procedure:

To examine the possibility of using wastes to improve the properties of soil in the sub base or below the foundation, various laboratory test were carried out. In the present experimentation work the soil is improved by adding industrial waste in different percentage. The effect of addition of industrial waste on the strength behavior of the soil is studied by varying percentage of industrial waste by weight of sample.

b) Planning for Laboratory tests:-

Soft murum which was proposed to be used for embankment were modified by mixing spent wash and fly ash. The test materials are obtained from Someshwar Sahakari Sakhar Karkhanana , At Post.Someshwarnagar Tal .Baramati Dist .Pune.

In the laboratory tests are conducted soil samples and spent wash and soil mixes together in decided proportion. The different tests conducted are

(1) Grain size analysis,

(2) Specific gravity

(3) Consistency limits and

(4) Standard Proctor test

The purpose of a laboratory compaction test is to determine the proper amount of mixing water to be used, when compacting the soil in the field and the resulting degree of denseness which can be expected from compaction at optimum moisture content.

To accomplish this, a laboratory test which will give a degree of compaction comparable to that obtained by the field method used necesary.

Standard Proctor Test Reference Standard:

IS: 2720(Part 7)-1980- Methods of test for soils: Determination of water content-dry density relation using light compaction.

Equipment's & Apparatus

Cylindrical mould & accessories [volume = 1000cm3] Rammer [2.6 kg], Balance [1g accuracy], Sieves [19mm] Mixing tray, Trowel,Graduated cylinder [500 ml capacity] Metal container

Formulaes:

1) $\Gamma_d = \frac{\Gamma}{(1+w)}\ kN/m3$

2) $I_p = WL - Wp$

C. Properties Of Test Material:-

1) Properties Of Soil:-

Properties	Value	Properties	Value
Colour	Light grey	Shape	Rounded /subrounded
SiO2 (%)	52%	Coefficient of uniformit, Cu	5.88
Al2O3 (%)	23%	Coefficient of Curvature ,Cc	1.55
Fe2O3 (%)	11%	Specific Gravity, G	2.38
CaO (%)	5%	Fineness as surface area m2/kg	420

TABLE I
Geotechnical Properties

2) Properties Of Fly Ash :-

A) Physical Properties:-

Sr. No.	Property	Soft Murum
1	Specific gravity	2.791
2	Particle size analysis	
	Gravel content% (20 to 4.75mm.)	24.62%
	Sand content % (4.75 to 0.075mm)	61.87%
	Silt and clay content % (below 0.075mm.)	13.21%
3	Atterberg"s Limits: %	
	Liquid limit	28.84
	Plastic limit	18.01
	Plasticity index	10.83
4	Maximum dry density (gm/cm3)	1.36
	Optimum Moisture Content (%)	15

TABLE I
Physical Property Of Fly Ash

Physical properties help in classifying the coal ashes for engineering purposes and some are related to engineering properties. The properties discussed are specific gravity, grain size Distribution, index properties and specific surface as well as classification.

This analysis show that fly ash mainly contain spherical size particle and have uniform gradation.

b) Compaction Behaviour:-

The density of coal ashes is an important parameter since it controls the strength, compressibility and permeability. Densification of ash improves the engineering properties. The compacted unit weight of the material depends on the amount and method of energy application, grain size distribution, plasticity characteristics and moisture content at compaction.

1) Properties Of Spent Wash:-

Table II
Physio Chemical Composition Of Distillery Spent Wash

Sr. No.	Physical properties	Spent wash
1.	Color	Dark brown
2.	Specific gravity	1.2
3.	Viscosity(cp at 200C)	1500
4.	PH	3.80
5.	Litters/tone	714
6.	Appearance	syrupy liquid
7.	Gallons/tone	157
8	Odour	Unpleasent burnt sugar
9	TDS(mg/L)	91700
10	TSS (mg /L)	26560
11	TS (mg/L)	118260
12	BOD (mg/L)	43000
13	COD (mg/L)	128000
14	Organic Carbon (%)	3.7
15	Nitrogen (mg/L)	1460
16	Phosphorus (mg/L)	326
17	Potassium (mg/L)	14300
18	Sodium (mg/L)	356
19	Calcium (mg/L)	6800
20	Magnesium (mg/L)	4384
21	Chloride (mg/L)	10650
22	Sulphate (mg/L)	3000
23	Copper (mg/L)	2.8
24	Manganese (mg/L)	9.2
25	Iron (mg/L)	24.6
26	Zinc (mg/L)	7.8
	Carbonates (mg/L)	Nil
	Bicarbonates (mg/L)	1530

Table III
Chemical Composition

Sr.No.	Chemical Composition	Spent wash
1.	Fiber	Nil
2.	Ash	10.59%
3.	SiO2	1.23
4.	K2O	28.38
5.	CaO	11.09
6.	MgO	7.23
7.	Na2O	20.05
8.	Fe2O3	0.46
9.	Al2O3	1.07
10.	SO3	11.33
11.	Chlorides	0.4

II. TESTS TABLES AND THEIR CURVES

Symbols	Proportion Soft Murum: spent wash	Proportion Soft Murum: fly ash
SM0	100:0%	100:0%
SM1	95: 5%	95: 5%
SM2	94.5: 5.5%	94.5: 5.5%
SM3	94 : 6.0%	94 : 6.0%
SM4	93.5: 6.5%	93.5: 6.5%
SM5	92.5 : 7.5%	92.5 : 7.5%

Table I
Details Of Soil Mix And The Symbols Used For The

Liquid limit (WL)	28.84
Plastic limit(WP)	18.01
Plasticity index(IP)	10.83
Maximum dry density (gm/cm3)	1.36
Optimum Moisture Content (%)	15

TABLE II
Details Of Soil Mix And The Symbols Used For Them.

Consistency Limit:-

Consistency means relative ease with which the soil can be deformed and this term is mostly used for fine grained material.–
` 1.Liquid state, 2. Plastic state , 3. Semi Solid state, 4. Solid state.
The effect of spent wash addition in varying proportion with soil has been studied and the variation inconsistency limits for various mixes are presented. It is found that as the percentage of spent wash increases the liquid limit of soil mix is increased.

Properties	Soil + spent wash Mix					
	SM 0	SM 1	SM2	SM 3	SM 4	SM5
Proportion Soil: spent wash	100: 0	95:5 %	94.5: 5.5%	94:6. 0%	93.5: 6.5%	92.5:7. 5 %
Atterberg"s limits: (%)						
Liquid Limit	28.84	30. 03	31.27	33.56	43.01	45.00
Plastic Limit	18.01	20.	21.37	24.46	34.5	37.10
Plasticity index	10.83	10.01	9. 9	9. 1	8. 51	7.90

TABLE I
Effect Of Spent Wash Addition On Atterberg"S Limit For Sm0 To Sm5

1) Compaction Behavior for Soil + Spent wash :-

The Standard Proctor"s test for soil with spent wash mixes are performed and presented. Typical curves for moisture content and dry density for various combinations. Similarly, effect of addition of spent wash with soil for MDD.

Table II
Effect Of Spent Wash Addition On Maximum Dry Density And Optimum Moisture Content For Soil.

Sr. No.	Properties	Soil + Spent wash Mix					
		SM0	SM1	SM 2	SM 3	SM 4	SM 5
	Proportion Soil: Spent wash	100: 0	95:5 %	94.5 :5.5 %	94: 6.0 %	935 :6. 5%	92. 5:7 .5 %
1.	Maximum Dry Density (gm/cm3)	1.36	2.04	2.00	2.1 0	2.1 1	2.0 0
2.	Optimum Moisture Content (%)	15.0 0	18.0 6	11.0 0	13. 00	16. 20	24. 60

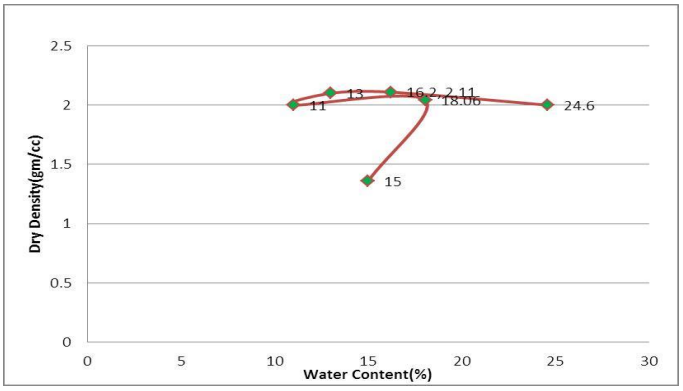
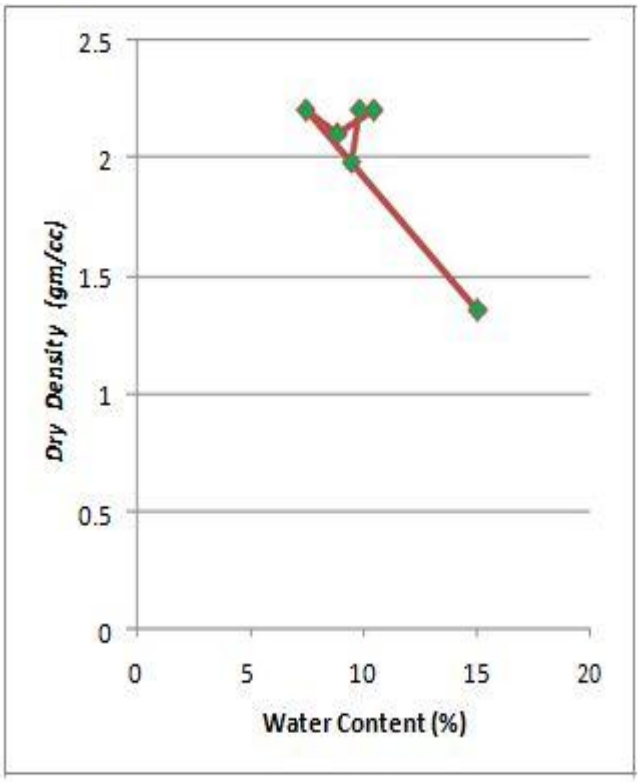


Table II
Effect Of Fly Ash Addition On Maximum Dry Density And Optimum Moisture Content For Soil.

Properties	Soil + Fly Ash Mix					
	SM 0	SM 1	SM 2	SM 3	SM4	SM5
Proportion Soil: Fly Ash	100 : 0	95:5 %	94.5: 5.5%	94:6 .0%	935: 6.5%	92.5: 7.5%
Maximum Dry Density (gm/cm3)	1.36	2.2	2.1	2.2	2.2	1.98
Optimum Moisture Content (%)	15	7.4	8.8	10.4	9.8	9.4



2) ECONOMY ACHIEVED USING SPENT WASH

Industrial wastes are used for constructing different layers of road pavements. Utilization of industrial waste for stabilization of sub grade depends on the interaction between industrial wastes and embankment soil.

If the type of soil available in the area is found be amendable to pozzolanic action with industrial wastes are added. This characteristic of industrial wastes is important in formulation of pavement specifications. With this economy can be achieved and utilization of industrial wastes in bulk quantities for road construction.

Sugar waste spent wash is a liquid that improves the soil density and decreases the OMC, Plasticity index of soil. The main feature of spent wash utilization in road construction is remarkable cost savings aspect. Spent wash saves cost as it is getting free of cost from sugar cane industries.

III. CONCLUSION

The summary of the present study, the major conclusions are drawn, the use of industrial waste material in the construction field and future scope of the investigation. On the basis of the results obtained in the experimental investigation, the following conclusions have been drawn:-

Soft murum used is found to be sandy soil. This soil is not suitable for such grade, for embankment and hence needs modification. Soil is modified with spent wash and fly ash individually by 5%, 5.5% 6.0%, 6.5%, and 7.5%.

The maximum increase in Maximum Dry Density by addition of 6.5% spent wash and 5% of fly ash due to proper rearrangement of modified soil mix it leads to have more strength. By addition of 6.5% of spent wash and 5% of fly ash individually in soil, the value of liquid limit, plastic limit is increased and plasticity index of modified soil is reduced.

Based on the cost analysis made it clearly show that use of spent wash and fly ash in road construction is economical. Industrial waste like spent wash combinations have significant potential to be used in place of conventional material for various road constructions and should be projected for future construction.

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