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"Effective Utilization of Industrial Waste & Agriculture Waste in Concrete and Soil for Road Pavement"

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Abstract — *India is developing country with rapid acceleration in GPD due to tremendous development in Infrastructure. Roads are major part of any country's infrastructure which plays important part in movement of people and goods. But in a construction of roads Majorly Road Construction is an activity in which utilization of natural recourses more due to which natural recourses get hampered.On other hand the waste form industry like steel slag produces in large quantities ,the dumping of such waste become serious issue to environment now a days and recycle of these waste not economical. Agricultural development also at peak period in our country the production from agricultural further used for production of food materials like sugarcane ,which is used for production of sugar, but along with these production some harmful by product also produce like Vinnasse, a the disposal of vinnasse also affect environmental balance.*

To overcome this problem effective use of industrial and agricultural waste is required and use of In this research paper the effective manner is to use slag in concrete by replacing natural coarse aggregate. In this study, the replacement was done with coarse aggregate by steel slag for different proportions of 0%, 25%, 50%, 75% and 100% for a M30 grade of concrete is used for a water cement ratio of 0.48. Tests for compressive strength at 7 days, 14days and 28 days are conducted on specimens. Split tensile strength and flexural strength are carried for 28 days. The optimum strength is obtained on 75% replacement of coarse aggregate by steel slag. Further experimental investigations have been made to study the suitability of Vinnasse (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 7.California Bearing Ratio test and 8.Standard Proctor Tests over various soil specimen with varying percentage of Vinnasse addition (5%, 5.5%, 6%, 6.5% and 7.5%) , test results are find out satisfactory.

Keywords- *Cement, Compressive Strength, Flexural Strength, Natural Coarse Aggregates, Split Tensile Strength, Steel Slag*

I. INTRODUCTION

Construction materials are massively used in all construction activity. Out of which concrete is the most important material for any type of construction work, but ingredients of concrete is produced by natural resources. In our country limited natural resources are available also during the production of ingredients environmental imbalance can happen specially during cement production industries liberates large amount of carbon dioxide which causes ozone depletion (Kanmalai, 2008). This trouble creates an issue on the sustainability of concrete. In magnitude to get realistic a sustainable significant, suitable discipline approaches can be done. as aggregates in asphalt paving road mixes due to their mechanical strength, stiffness, consistency, wear resistance and water absorption. Steel slag generally exhibits the passa bleness to change due to the presence of un-hydrated remove hydroxide and magnesium oxides which hydrate in humid environments. The steel slag which obtained from Jagadamba Steel Sanaswadi and Vinnasse obtained from Kisan Veer Sugar Factory Bhuinj Maharashtra India

II METHODOLOGY

A) Test On concrete

Number of basic tests is conducted on Ordinary Portland Cement 53 grade, fine aggregate, coarse aggregate and steel slag for checking their suitability for making concrete. Mix proportions of concrete are modified for using EAF steel slag with partial replacement of coarse aggregate replaced with 0%, 25%, 50%, 75% and 100% of steel slag casted in cubes. Specimens are cast as per design mix and the tests are conducted after proper curing, the tests are compressive strength of cubes (150mm x 150mm x 150mm), split tensile strength of cylinders (150mm x 300mm) and flexural strength of cubes (100mm x 100mm x 500mm). From the studies, optimum results are found out and compared with the control concrete.

III MIX PROPORTION

Concrete mix design is a process in which the proportions of the various raw materials of concrete are determined to achieve a certain minimum strength, as economically as possible. Based on the simplified mix design procedure as per IS 10262:2009, a concrete mix proportions with characteristic compressive strength (fck) of 30Mpa was designed without any admixtures for water cement ratio 0.48. The mix adopted for the study is given in Table 2.

TABLE 1: MIX PROPORTION CEMENT

	Cement	Water	Fine Aggregate	Coarse Aggregate
kg/m3	377.5	176ltr	670	1100
Ratio	1	0.48	1.75	2.86

IV.TEST RESULTS AND DISCUSSION

The test results of slump cone, compressive strength, flexural strength and split tensile strength obtained from the experimental study are given in the form of graph along with discussion.

A. Slump test

Slump test is conducted on fresh concrete of different design mix proportions. The obtained slump value for control concrete is 50 mm. This indicates medium workability.

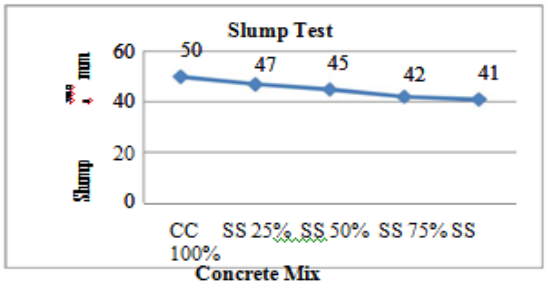

Fig 1: slump value of concrete.

Fig.1 above is shows the variation of slump value of concrete using steel slag. From the graph it is concluded that in concrete as percentage of steel slag increases it decreases the workability.

B. Compressive strength

Specimen are casted in concrete cubes of sizes 150 mm X 150 mm X 150 mm and are cured, it is tested for compressive strength under compression testing machine (CTM). The maximum load at failure reading was taken. Fig.2 shows the compressive strength of concrete using steel slag at 7th, 14 th and 28th day.

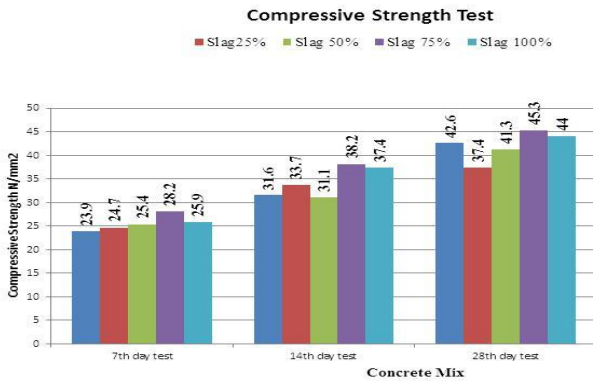

Fig.2 compressive strength of concrete

It was observed that the strength of concrete increases with the increase in the quantity of steel slag as replacement to natural aggregates. Up to 75% replacement of coarse aggregates by steel slag. The compressive strength of concrete of all concrete mix increases up to 75% but decrease after 75% .The compressive strength of concrete increases 14 % if 75% of

coarse aggregate is replaced by steel slag. The improvement in strength may be due to shape, size and surface texture of steel slag aggregates, which provide better bonding between the particles and cement paste.

.C Split tensile strength

Concrete cylinders having diameter 150 mm and height 300mm were casted and the specimens are cured, specimens are tested for split tensile on 28th day.

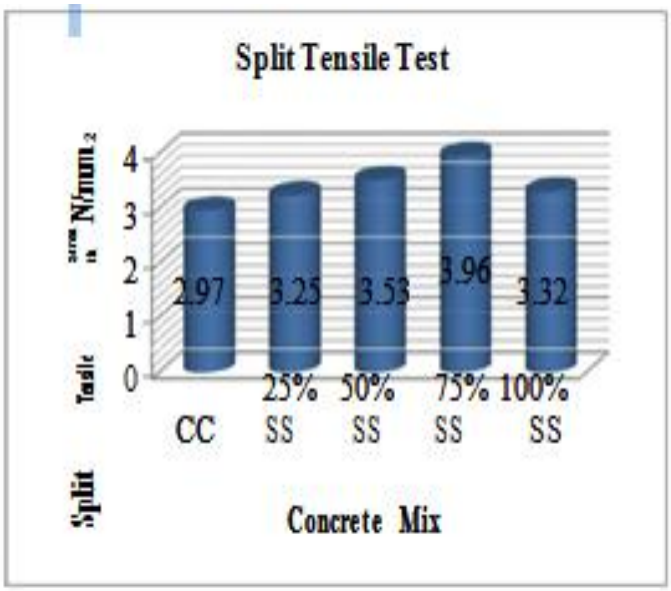

FIG 3: SPLIT TENSILE STRENGTH OF CONCRETE

The flexural strength test for beam specimen having the size of 100 x 100 x 500 mm was casted and cured for 28 days. It was kept horizontally between the supports of a universal testing machine (UTM) and the load is applied until failure of the beam. The failure load is noted and shorter length from crack to support strength measured. Fig.4 shows the flexural strength of concrete using steel slag at 28th day. It is observed that flexural strength of concrete increases with the increase in the quantity of steel slag as replacement of coarse aggregate. Up to 75% of replacement by steel slag, the flexural strength of concrete increases but beyond 75% decrease in the strength was observed. The maximum increase in the flexural strength obtained at 75% replacement and the flexural strength of concrete increases 15.43 % compared with control concrete.

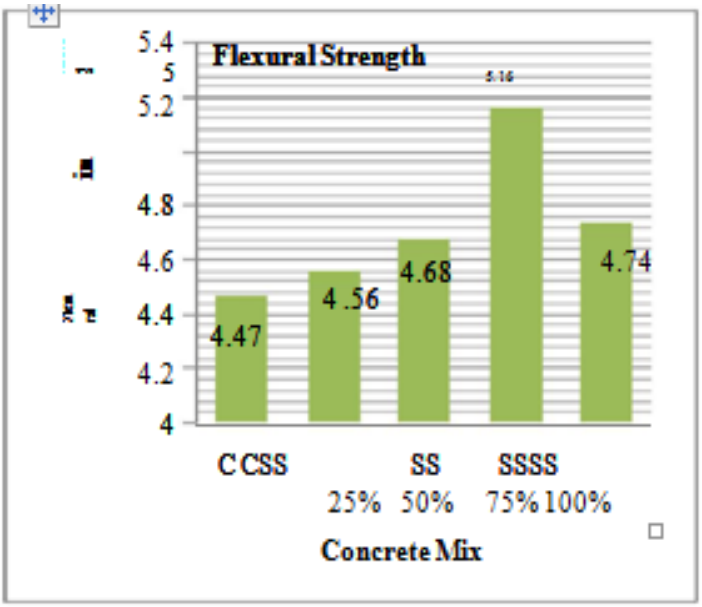

Fig:4 Flexural strength of concrete using steel slag.

IV TESTS TABLES AND THEIR CURVE

Table No 2: Details Of Soil Mix And The Symbols Used For Them

Symbols	Proportion Soft Murum: Vinnasse	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 No 3 :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

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 Vinnasse 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 Vinnasse increases the liquid limit of soil mix is increased.

Table 7 : Effect Of Vinnasse Addition On Atterberg"S Limit For Sm0 To Sm5

Properties	Soil + Vinnasse 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

1) Compaction Behavior for Soil + Vinnasse :-

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

Table 8: Effect Of Vinnasse Addition On Maximum Dry Density And Optimum Moisture Content For Soil.

Sr. No.	Properties	Soil + Vinnasse 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

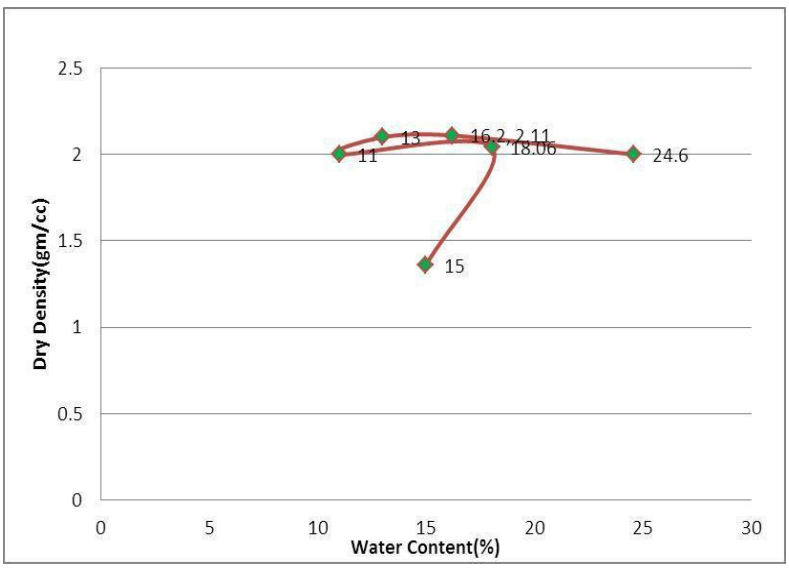

Fig:5 Effect Of Vinnasse Addition On Maximum Dry Density And Optimum Moisture Content For Soil.

Table No 9 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

V CONCLUSION

A: From the experimental works carried out, the following conclusions are made. After this experimental study, it has proved to be better way to for disposal of steel slag. The replacement of coarse aggregate with EAF steel slag has increased the compressive strength, flexural strength and split tensile strength of concrete. The optimum percentage of steel slag was found to be 75%. As we increase the percentage of steel slag in concrete it shows higher resistance to acid and sulphate attack. When this optimized value will be used, it will give more durable concrete and good strength when compared to conventional concrete and saves material cost up to 10%.

B: 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 Vinnasse 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% Vinnasse 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 Vinnasse 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 Vinnasse and fly ash in road construction is economical. Industrial waste like Vinnasse 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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