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USE OF STEEL SLAG IN FLEXIBLE PAVEMENT

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Abstract : The disposal of Industrial Waste is becoming a very large problem and industrial waste is increasing day by day. Now It is necessity to use the steel slag waste through technical development in each field. Its disposal causing severe health and environmental hazards in road construction industries is gradually gaining significant importance in India considering the disposal, environmental problems and gradual depletion of natural resources like soil and aggregates The waste material which is a by-product during the manufacturing of steel from steel industries is Steel Slag. The quantity of generation is around 24 lacs MT per year from (Ref.Report.CRRI-2010) different steel industries in the India. Presently, it has no applications and dumped haphazardly on the costly land available near the plants. In this study, a typical steel slag was collected from an M/s Tata Steel industry Pvt. Ltd. Jaipur , (M.S) in India and its feasibility for use in different layers of road construction was investigated. To improve its Geotechnical engineering properties, the Steel Slag material was mechanically stabilized with locally available soil in the range of 5 – 25%. to investigate their suitability in the construction of different layers of road Technical specification Geotechnical parameters of these stabilized mixes were evaluated. Construction of embankment, sub grade and sub base layer of Flexible pavement can be done through steel slag.

1. INTRODUCTION

The blast furnace slag and steel making slag are two category through which iron and steel slag can be generated as a byproduct of iron and steel manufacturing processes. Blast furnace slag is recovered by melting separation from blast furnaces that produce molten pig iron. Blastfurnace slag consists of non-ferrous components contained in the iron ore together with limestone as an auxiliary materials and ash from coke. It is classified either as air-cooled slag or granulated slag according to the cooling method used. The steel scrap is used in converter and electric arc furnace steel making process through which electric arc furnace slag is generated. Through electric arc furnace slag basic oxygen furnace slag is generated which is constituent of Steel slag. In the present study, solid waste which is generated as a by-product, during the melting process of mixed materials viz. steel scrap, sponge iron, pig iron, ferro-silicon, silico-manganese and Al-shots is termed as granulated blast furnace slag. The waste material is neutral and non hazardous in nature as per chemical analysis report of Central Pollution Control Board India (CPCB). The quantity of generation of this slag is around 24 lacs MT per year from different steel industries in India (CRRI, 2010). Steel slag may be used as a land fill cover liner (Inga, 2010, Ref. No-18.) Pazhani and Jeyaraj (2010, Ref. No-20) studied feasibility of Granulated Blast Furnace slag (GBFS) for production of high performance concrete. Use of steel slag in asphaltic concrete minimizes potential expansion and takes advantage of the positive features in giving high stability, stripping resistant asphalt mixes with excellent skid resistance (Emery, 1994 and Mullick2005, Ref. No-21).

Presently, this Steel Slag is not utilized and is dumped on the costly land available near the plants. Study was carried out to utilize the slag in different layers of road construction. Being cohesion less material, it was mixed with local soil in the range of 5-25% and their geotechnical characteristics were evaluated. Technical specifications of slag were developed for utilization in the construction of embankment, sub grade, sub base layers of road pavement. Slag was investigated for its feasibility in bituminous layers.

2. MATERIAL

Slag sample was collected from M/s Jindal Steel Pvt .Ltd Industry in Sinnar MIDC Nashik, State of Maharashtra, India. It was selected from different locations of the heap and mixed thoroughly before using it for laboratory study. Local soil was also collected from Field National Highway No-6`,Use of local soil should be collected and different layers in field to check Geotechnical properties of Local soil and Steel Slag in various percentage mixes.

3. GEOTECHNICAL CHARATERISATION OF SLAG, LOCALLY AVAILABE SOIL AND THEIR MIXES

The geotechnical characteristics of steel slag locally available soil and their mixtures were investigated to study their feasibility in different layers of road pavement. Construction of road embankment using slag alone would not be feasible as it is cohesion less material. Such embankments would be highly erodible. Therefore , it was mixed with local soil in the rang of 20-60% and their geotechnical characteristics were investigated .

Table – mixes and their mix designation

Mix Designation	Mixes
100LS	100% Local soil
6S+94LS	6 % Steel Slag + 94 % Local Soil
12S+88LS	12 % Steel Slag + 88 % Local Soil
18S+82LS	18 % Steel Slag + 82 % Local Soil
24S+76LS	24 % Steel Slag + 76 % Local Soil
30S+70LS	30 % Steel Slag + 70 % Local Soil
100S	100% Steel Slag

4. EXPERIMENTAL WORK

A. Specific Gravity Test

Specific gravity test was carried out as per IS 2720 Part 3 (1980). Specific gravity of steel slag and local soil was observed to be 4.28 and 2.10 respectively.

B. Grain Size Analysis

Grain size analysis was carried out of slag and local soil as per IS 2720 part 4 (1985). Slag and local soil samples were observed to be coarse grained materials. Slag was crushed by roller and grain size analysis was also carried out. Cu and Cc Values find out.

Table-2.Values of Cu and Cc

Coefficient of uniformity (Cu)	12.87
Coefficient of curvature (Cc)	1.94

C. Atterberg limit test

Atterberg limit test was carried out as part 5 (1985). Oven dried samples were used to deteremine the liguid limit and plastic limit. Slag and their mixes were observed to be non plastix in nature . The liquid limit and plastic limit of local soil were determined as 47% and 26% .

D. Moisture absorption test

To know the voids in slag , moisture absorption test is carried out as per BIS 2386 part 3 (1997). Moisture absorption value of steel slag was obtained as 10%

E. Modified proctor compaction test

To asses the compaction properties of selected materials, their mixes and effect of varying relative proportion of two materials, modified proctor compaction test was carried out . The maximum dry density of slag and local soil was found to be 21.5 kN/m3 and 17.3 kN/m3 and OMC of 6% and 10%.

Table - Values of OMC and MDD for various MiX

Type of Mix	OMC (%)	MDD (KN/m^3)
100LS	11.9	17.00
6S+94LS	10.11	17.30
12S+88LS	9.67	15.63
18S+82LS	9.6	18.90
24S+76LS	11.45	20.40
30S+70LS	11.8	20.80
100S	9.45	24.50

5. CONCLUSION

The feasibility of utilizing of steel slag and local soil in construction of flexible pavement with variation of percentage in soil.
The following conclusions have been drawn .

[1] It is observed that in th local soil and steel slag mix with the increase in steel slag content there is an increase in MDD with the corresponding decrease in OMC.

[2] High specific gravity and maximum dry density of slag as compared to local soil may be due to high percentage of iron oxide present in the slag

[3] Slag was observed to be highly crushable while soil was non crushable. When generated slag is being rolled by a roller, it is observed that gravel size material gets chaned to sand size material. The material is also observed to be porous as indicated by moisture absorption test.

[4] Local soil is material having specific gravity of 2.17 and steel slag having specific gravity of 4.78.

6. REFERENCES

[1] C.N.V. Satyanarayana Reddy and K. Durga Rani (2013) Potential of Shredded Scrap Tyres In Flexible Pavement Construction, Indian Highways, October 2013 pp 7-12.

[2] Ahmed Ebrahim Abu El-Maaty Behiry(2012) "Evaluation of steel slag and crushed limestone mixtures as subbase material in flexible pavement" Ain Shams Engineering Journal Vol .4(2012), pp 43–53.

[3] K V Subrahmanyam, U Arun Kumar, Dr. PVV Satyanarayana,(2014) A Comparative Study on Utilization of Waste Materials in GSB Layer, SSRG International Journal of Civil Engineering (SSRG-IJCE) – Vol.1.Issue3 Aug. 2014 ISSN: 2348 – 8352,pp.10-14.

[4] Dr. D S V Prasad, Dr. G V R Prasada Raju, M Anjan Kumar(2009),Utilization of Industrial Waste in Flexible Pavement Construction.EJGE Journal Vol. 13, Bund. D,pp.1-12.

[5] M. M. A. Aziz, M. Shokri, A. Ahsan, H. Y. Liu, and L. Tay.(2015) An Overview on the Performance of Steel Slag in Highway Industry, Journal of Advanced Review on Scientific Research**,** ISSN (online): 2289-7887,(2015), Vol. 5, No.1. Pp.30-41.

[6] Niraj D. Baraiya,(2013),Use of Waste Rubber Tyres in Construction of Bituminous Road – An Overview, International Journal of Application or Innovation in Engg & Management (IJAIEM),ISSN 2319 - 4847,(2013) Vol.2, Issue.7,July-2013,pp.108-110.

[7] Tara Sen and Umesh Mishra,(2010)Usage of Industrial Waste Products in Village Road Construction, International Journal of Environmental Science & Development,ISSN:2010-0264,(2013), Vol.1, No.2, June 2010,pp.122-126.

[8] Zore T. D, S. S. Valunjkar (2010) Utilization of Fly Ash and Steel Slag in Road Construction A Comparative Study,(2010),EGJE Journal,Vol.15,Bund.Q,pp.1864-1870.