

“Utilization of industrial waste in the construction Flexible Pavement by Marshall Method”

Civil Engineering

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ABSTRACT

The disposals of different industrial wastes pose environmental problems to the society as many of them are non-biodegradable. India having the huge network of industries and many more are being established since it is a developing country. With each passing year several million metric tons of waste is getting increased. As the usage of road increases the use of unconventional ingredients also increases. The inclusion of several other secondary materials and industrial wastes may be a boon in preserving natural reserves and conventional materials. These materials have been evaluated and investigated for practicing and utilizing in various ways in construction industry. Many materials like plastic wastes, scrap tires, mine wastes, crushed glass, foundry sand etc. This study aims to give a significant demonstration on the use of blast furnace slag which is an industrial waste- by product in the construction of pavement.

CHAPTER 1

1.INTRODUCTION

In today's world, life without roads cars motorcycles trucks is all unimaginable. India has the second largest road network within the world spending a complete of 5.89 million kilometres period this road network transports 64.5% of all goods within the country and 90% of India's total passenger traffic which uses road network for commuting as of October 21st 2020. road transport is one amongst the foremost common modes of transport and also gives the most service to any or all, let it's within the style of trackways, human pathways, etc. Since then many experiments work performed to create the writing safe and comfy. Hence, building became and inseparable a part of many civilizations and empires.

India is one in all the highest 10 countries in terms of commercial growth leading to an unlimited production of business waste. the speed of business waste is increasing faster than the speed of globalization. This waste disposal has become a heavy problem today which is threatening the environment and extinction of resources. The two styles of pavement structures generally used are I) Flexible II) Rigid. Wastes from different sources will be collected and also the materials like foundry sand, iron slag, steel slag, glass waste, ceramic waste etc., may be used. The slag is of two types i.e., furnace slag and steel making slag. The furnace slag is obtained by melting the separated from furnace that produces iron.

For each ton of iron approximately 290kg of slag is produced. This study aims at reducing the price of construction of flexible pavements.

CHAPTER 2

2. LITREATURE REVIEW

2.1 Review: 1

Sagar C et al; Utilization of Waste Materials in Flexible Pavement Construction 2018

The waste added in the bituminous mixes can increase the stability and density of the mix which is designed for the surface course. It is found that, the stability is increased twice, when compared to the normal bituminous mix i.e. with adding waste materials. Due to use of waste materials the cost reduction is up to 25 % when compare to ordinary bitumen.

2.1 Review:2

S. Rajesekaran, Dr. R. Vasudevan, Dr. Samuvel Paulraj has been studied “Reuse of Waste Plastic Coated Aggregate- Bitumen Mix Composite for Road Application-Green method” (2013).

Waste plastics both by domestic and industrial sector scan be used in the production of asphalt mix. Waste plastic, mainly used for packing are made up of polyethylene, polypropylene, polystyrene this softening varies between 110°C-140°C and they do not produce any toxic gases during heating but the softened plastics have tendency to form a film like structure over the aggregate when they sprayed over the hot aggregate @ 160°C. this PCA bitumen mix showed improved binding property and less wetting property and it also showed higher Marshall stability value in the range of 18-20KN and load bearing capacity of the road is increased by 100%. The roads laid since 2002 using PCA bitumen mixes are performing well. This added more value to the dry process as this process helps to dispose 80 percentage of waste polymers usefully by an eco-friendly method and also it reduced the cost to around Rs.3000/km of single lane road as on date.

2.1 Review:3

H.K.Sharma, has conducted experiment on “Utilization of Waste Plastic in Construction of Pavement” (2014).

He found that Waste plastics-as binder and modifier at 130°C using Thermogravimetric analysis there is no gas evolution in the temperature range of 130-180°C. Moreover, the softened plastics have a binding property. Hence, the molten plastics materials can be used as a binder and/or they can be mixed with binder like bitumen to enhance their binding property. This may be a good modifier for the bitumen, used for road construction. The uses of plastic waste help in substantially improving the abrasion and slip resistance of

flexible pavement and also allows to obtain values of splitting tensile strength satisfied the specified limits while plastic waste content is beyond 30% by weight of mix. If the consistent.

2.1 Review:4

DR.Manju, Sathya.S, Sheema.K has been studied on “use of plastic waste bituminous pavement”(2017).

This paper reveals that the utilization of waste plastic in bituminous mix enhances its properties and strength. Titanium Di-oxide is used as smoke absorbent material, which will absorb the smoke from vehicle. Addition of waste plastic in construction reduces the plastic shrinkage and drying shrinkage. Dry process is carried out for mixing process. The plastic pavement can stand heavy traffic and are durable than flexible pavements. The stability of modified bitumen (10% bitumen replaced by plastic) is higher than the nominal bitumen. The use of plastic will reduce the bitumen content by 10% increases the strength and performance of the road. The smoke absorbent material (titanium dioxide) by 10% of polymer content can reduce vehicular pollution. Thus the use of waste plastic improves the abrasion and slip resistance of bitumen pavement[2].

2.1 Review:5

Vishal Rasal, L Nokfho K, P.M.Wale, Mrunalini Kasar, Anjali Thorat, Raunak Solanki, Ishan Dharmadikari, has been studied on “Experimental Study on Modified Bituminous Mix Using Waste High Density Polyethylene and Crumb Rubber”(2018).

This paper presents an effort taken to produce modified bituminous mix and coated aggregates. Aggregate were coated with 6, 8, 10% of High density polyethylene (HDPE) and 8, 10, 12% of crumb rubber and were mixed with bitumen. Different molds are prepared with different combination and compared with conventional bitumen mix by conducting Marshall Stability test to check its strength, flow value and stability value. The dense based macadam (DBM) mix was designed for Marshall Stability test using VG 30 grade. Dry process (polymer coating of aggregates) is more useful as compared to wet process (adding polymer in the binder) for the manufacturing modified mixtures, as it can accommodate higher amount of waste plastic as modifier and results most stable mixture. Penetration values and softening points of plain bitumen can be improved by modifying it with addition of crumb rubber. Optimum percentage of rubber was found to be 8% and 10% of HDPE gives more satisfied results comparing to conventional bitumen. Use of waste plastic in construction of bituminous road helps to improve strength, life of road, resistance to temperature and water

CHAPTER 3

3. OBJECTIVES

The purpose of this project is to know the concepts of design performance and analysis of flexible pavements. This project are specializing in some specific areas:

- To study the usage of industrial wastes and try easing the cost of construction of flexible pavements : long design life with low maintenance cost, maximum economy safety and serviceability over the planning period, maximum load carrying capacity
- To study the physical properties of industrial waste materials : Review of engineering materials used for pavement construction empire and mechanistic design methodologies for flexible pavement construction
- To find out the percentage of steel slag : structurally strong to face up to every kind of stresses imposed upon it and smooth surface to supply comfort to road users even at high speed and produced least noise from moving vehicles, dust proof surface in order that traffic safety isn't impaired by reducing visibility
- To study the properties of bituminous mix & to find a solution for disposal in a useful way : minimum or limited destruction of adjoining land use, maximum or good aesthetics
- To study the variation in the Marshall Stability value.

CHAPTER 4

4. METHODOLOGY

4.1 Steel slag

Slag is generated as a by-product during the manufacturing of pig iron & steel. During the process of making of pig iron (in the blast furnace) and production of steel (in steel melting shop), slag is produced as a by-product by the action of fluxes upon gangue materials with the iron ore. The slag primarily consists of silicon, calcium, aluminum, iron, magnesium & manganese in various combinations. Under controlled cooling slag becomes hard and dense, which can achieve the required strength to sustain heavy loads thus making it especially suitable for use in road construction.

4.2 Bitumen

There are many ways in which bitumen can be used. They are like sealing, flat roofs, water proofing products. But mostly 70% of asphalt / bitumen is used in road construction. It acts as the glue or binder to aggregate mix and creates the asphalt concrete. VG 30 grade of bitumen is used in this project.



FIG:1 BITUMEN

The engineering properties of bitumen which are obtained from the tests of ductility, softening point, penetration test, flash test, fire test, and specific gravity tests are shown in the following table:

Table 1 Properties of Bitumen

S.NO	Property	Bitumen	IS Specifications
1.	Ductility[at 27 ⁰ C]	76cm	Min.75
2.	Softening point[ring & ball]	68 ⁰	35-70
3.	Penetration test[25 ⁰ C,0.1 mm, 100 gm, 5 sec]	65cm	80-100
	Grade	VG30	80/100
4.	Flash and fire point	218 ⁰ c flash) & 238 ⁰ c fire)	-
5.	Specific Gravity[at 27 ⁰ C]	0.98	0.97-1.02

4.3 Plastic

A plastic is a material that contains one or more organic polymers of large molecular weight, solid in its finished state and at some state while manufacturing or processing into finished articles, can be shaped by its flow. Thermogravimetric analysis has shown that there is no gas evolution in the temperature range of 130-180°C. Moreover, the softened plastics have a binding property. Hence, the molten plastics materials can be used as a binder and/or they can be mixed with a binder like bitumen to enhance their binding property. This may be an honest modifier for the bitumen, used for road construction.

4.4 Aggregates

Aggregates are widely used in civil constructions like roads, foundations, railway roads and drainages. Aggregates are natural materials which are obtained by mining and blasting into certain sizes. It has good compressive strength properties.



FIG:2 AGGREGATES

Table 2 Properties of aggregate (75 %) +iron slag (25 %) mix and Normal aggregates

S.NO	Properties	Aggregates	Iron Slag (25%) +Aggregates (75%)	IS Specifications
1.	Impact (%)	16.83	23.91	Less than 30
2.	Abrasion (%)	33.55	37	Max. 30
3.	Specific gravity	2.85	2.62	2.6-2.9
4.	Water absorption	0.35	0.10	1
5.	Crushing (%)	24.92	28.30	Max.30

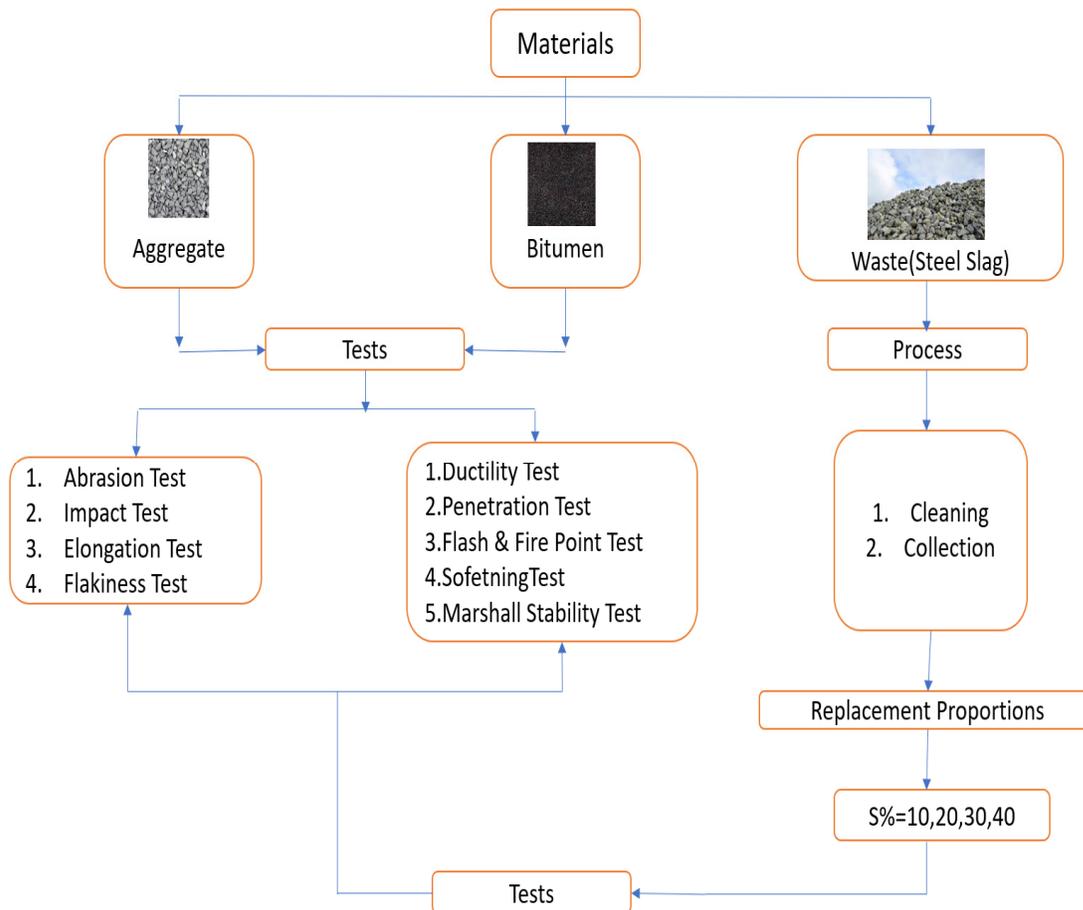
4.5 Gradation of Aggregates

Gradation has major impact on the performance of mix design. By gradation the voids are decreased by filling the smaller particles in between the voids created by large particles. Gradation of aggregates is done according to MoRTH specifications Section: 500

Table 3 Gradation Table.

IS Sieve(mm)	Cumulative % of passing weights
26.5	100
19	79-100
13.2	59-79
9.5	52-72
4.75	35-55
2.36	28-44
1.18	20-34
0.6	15-27
0.3	10-20
0.15	5-13
0.075	2-8

4.6.FLOWCHART



4.7. Marshall Stability

Marshall Stability is performed to find out the stability and flow values of specimen.

1. A specimen is prepared according to MoRTH specifications Section 500.

2. From the Marshall Stability test we get the following properties

- a) % of air voids (V_v).
- b) Specific gravity (G_t).
- c) % volume of bitumen (V_b).
- d) Bulk specific gravity (G_m).
- e) % voids in mixed aggregates (VMA).
- f) Voids filled with bitumen (VFB).

3. Graphs are plotted between bitumen content vs G_m, V_v, Stability, Flow, and VFB which are show in result and discussion section below.

CHAPTER 5

5. REFERENCES

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