Study on the Mechanical Properties of Bitumen Plastic Mix Flexible Pavement by Partially Replacing Coarse Aggregate with Cast Iron Slag

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***Abstract*—The plastic waste and industrial waste are major threat to environment. The utilization of plastic waste and partial replacement of cast iron slag with coarse aggregate in bituminous mixes will enhances its properties. The primary aim of the study isto analyze the effect of incorporating plastic- cast iron slag mix on the mechanical properties of flexible payment. The road traffic is increasing so the load bearingcapacities of road have to be increased. The plastic and the partial replacement of cast iron slag will be done at different dosages and compared based on their mechanical strength.**

***Index Terms*— cast iron slag, flexiblepavement, plastic**

I. INTRODUCTION

Any improvement in the property of the binderin a flexible pavement is needed in the present scenario. Bituminous mixes can be modified by adding plastic waste and partially replacing coarse aggregate with cast iron slag. These are inexpensive and lead to the waste management of plastic and industrial waste. By observing the performance of pavement, the future traffic level can be designed and modified.Increase of plastic waste can be effectively utilized by mixing it with the bituminous material. Recycling of plastic waste can also be done. Here we explore the effect of cast iron slag and plastic wastes as pavement construction material. Several tests are conducted on bituminous mix to check the properties. It is necessary to adopt bituminous material with good stability and flow.

II. OBJECTIVES

I. To carry out the experimental procedure by partially replacing the coarse aggregate with cast iron slag and adding plastic to bitumen.
II. To find out the suitable mix in terms of mechanical strength and temperature reduction.
III. Finding a way for the disposal of plastic and cast-iron slag

III. MATERIALS USED

3.1 Cast iron slag

During iron melting, the scrap material isexposed to high temperature and oxygen. Consequently, oxides are formed on the surface as a more or less viscous layer that can be removed. Slag is mainly a collection of compounds such as SiO2, Al2O3, Cao, FeO, MgO, MnO but can entrap cast iron droplets. The main properties of cast iron are they are highly angular in shape and have rough surface texture.

They have high bulk specific gravity and moderate water absorption. This slag possesses high strength and durability. And more resistance to abrasion.

3.2 Coarse Aggregate

Coarse aggregates are any particles greater than 0.19 inch, but generally range between 3/8 and 1.5 inches in diameter. The aggregate should be hard enough to resist the abrasive action caused by movements of traffic.

3.3 Bitumen

Bitumen is a sticky, black, and highly viscous liquid or semi-solid form of petroleum. It may befound in natural deposits or may be a refined product and is classed as a pitch. The primary use (70%) of asphalt is in road construction, where it is used as the glue or binder mixed with aggregate particles to create asphalt concrete. Its other main uses are for bituminous waterproofing products, including production of roofing felt and for sealing flat roofs.

3.4 Plastic

Plastics are a wide range of synthetic or semi-synthetic materials. It has a wide range of other properties, such as being lightweight, durable, flexible, and inexpensive to produce. It causes widespread environmental problems due to their slow decomposition rate in natural ecosystems. Only solution for reducing the plastic waste is byrecycling it. Here the shredded plastic in less parentage is added along with bitumen toimprove the performance

IV. MIX DESIGN

TRIAL	PLASTIC	CAST IRON SLAG			
1	5%	10%	20%	30%	40%
2	10%	10%	20%	30%	40%
3	15%	10%	20%	30%	40%

V.TEST RESULTS

5.1 Test results on aggregates and cast-iron slag

NAME OF THE EXPERIMENT	VALUES OBTAINED ON AGGREGAT ES	VALUES OBTAINED ON CAST IRONSLAG
Aggregate Impact Value	20.9%	25.5%
AggregateCrushing Value	28.6%	29.9%
SpecificGravity	2.66	2.62
Water Absorption	0.35%	0.36%
Los AngelesAbrasion Value	21.66%	19.78%

5.2 Test results on Marshall stability test

% of cast iron slag and plastics	*Marshall stability value(kg)*	*Flow Value%*	*Air voids %*	*Voids filled with bitumen %*
0% Plastic 0% cast iron slag	*1529.34*	*2.45*	*3.62*	*73.21*
5% Plastic 10% cast iron slag	*1615.26*	*1.89*	*3.3*	*72.58*
5% Plastic 20% cast iron slag	*1725.36*	*2.87*	*3.12*	*74.43*
5% Plastic 30% cast iron slag	*1306.5*	*2.51*	*4.86*	*65.58*
5% Plastic 40% cast iron slag	*1696.71*	*2.32*	*2.72*	*77.62*
10% Plastic 10% cast iron slag	*1358.04*	*3.22*	*3.27*	*73.69*
10% Plastic 20% cast iron slag	*1585.47*	*2.94*	*4.30*	*67.18*
10% Plastic	*1348. 35*	*3.16*	*4.49*	*69.57*

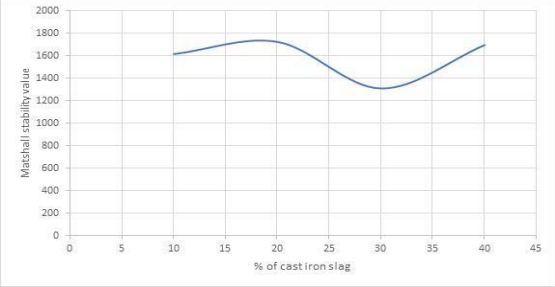
30% cast iron slag				
10% Plastic 40% cast iron slag	*1205.01*	*2.40*	*3.24*	*71.19*
15% Plastic 10% cast iron slag	*728.31*	*3.36*	*4.93*	*62.3*
15% Plastic 20% cast iron slag	*912.08*	*3.19*	*5.15*	*59.39*
15% Plastic 30% cast iron slag	*1340.82*	*2.90*	*4.26*	*68.13*
15% Plastic 40% cast iron slag	*1474*	*2.45*	*6.12*	*58.02*

5.3 Test results on bitumen

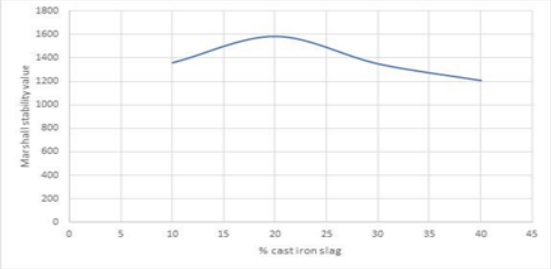
NAMEOF EXPE RIMENT	VALUE OBTAINED			
	WITHOUT PLASTIC	WITH PLASTIC		
		5%	10%	15%
Specific Gravity	1.02	1.12	1.38	1.20
Penetration Test	30.8mm	28.2mm	27.8mm	33.5mm
Softening Point test	55℃	57.5℃	59.1℃	61.4℃
Ductility Test	75cm	76cm	78cm	69cm
Extraction Test			4.06 %	

VI.GRAPHICAL REPRESENTATIONSOF MARSHALL STABILITY TEST

MARSHALL VALUE GRAPH

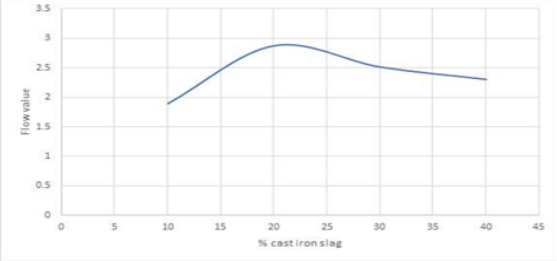


For 5% Plastic

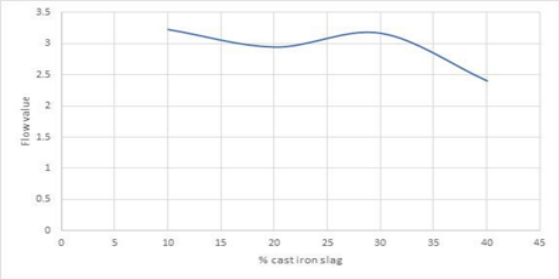


For 10% Plastic

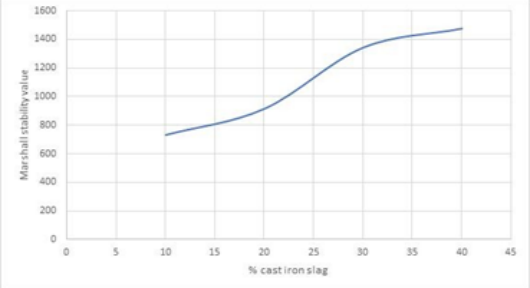
6.1 FLOW VALUE GRAPH



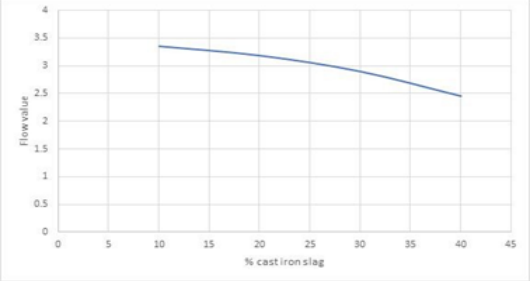
For 5% plastic



For 10% plastic

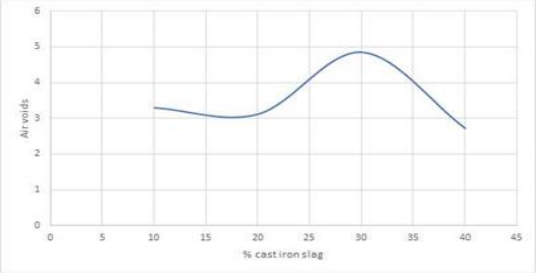


For 15 % Plastic

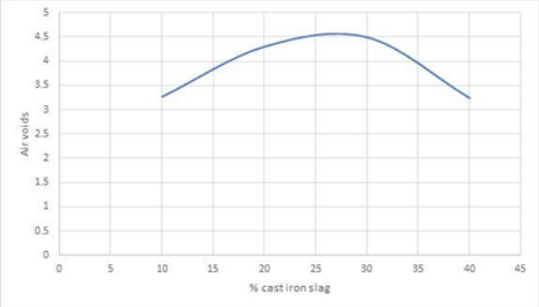


For 15% plastic

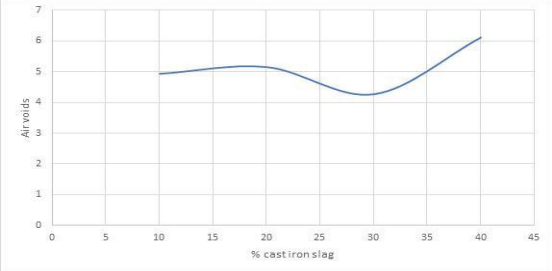
6.2 AIR VOIDS GRAPH



For 5%plastic

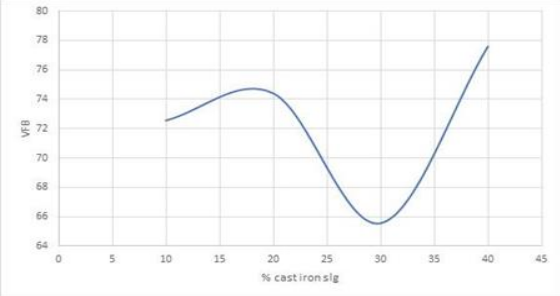


For 10%plastic

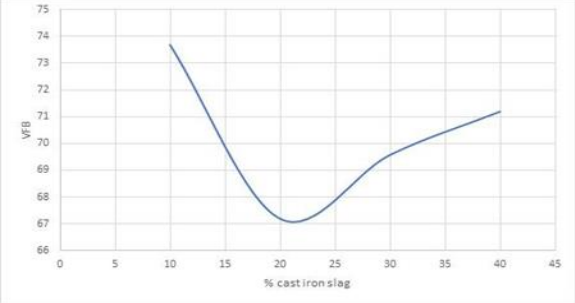


For 15%plastic

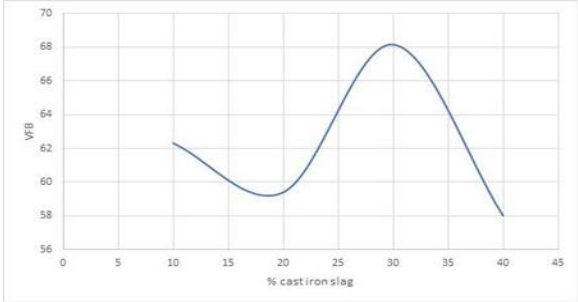
6.3 VOIDS FILLED WITH BITUMENGRAPH



For 5% plastic



For 10% plastic



For 15% plastic

VII. CONCLUSION

6.3.1 By using plastic, reduce the use ofplastic so less expensive

6.3.2 Expecting the pavement with high strength and better performance

6.3.3 Pavement with high durability

6.3.4 Usage of waste materials leads to waste management

6.3.5 During this process the cracks on this pavement is reduced thus lessmaintenance

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