International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST52310383

Experimental Investigation of Bitumen Concrete mix with Use of Ceramic Waste and Rise Husk Ash as a Partial Replacement of Filler and Aggregate

Sameer KR. Kushwaha
M Tech (Highway Engineering), Maharishi University of Information Technology, Lucknow, India

ARTICLEINFO

Article History:
Accepted: 02 May 2023
Published: 24 May 2023

Publication Issue
Volume 10, Issue 3
May-June-2023

Page Number
379-385

ABSTRACT

Bituminous concrete are most widely used in present era. The cost of bitumen is increase day by day and lack of availability of natural resources increased . for that reason there are an opportunity to use local material resources such as ceramic waste (CW) silica flumes, slag, plastic,rise husk ash (ash) are by product which is a bad Environmental hazard causing damage destroy the land and surrounding area in which it is dumped .To deal with this problem,we are studying and test of material in lab of the mechanical performance of bituminous concrete using ceramic waste and rise husk ash a different proportion 4%,6%,8% and 3%,4%,5% respectively at a different bitumen content as a partial replacement of filler and aggregate material .In this lab test marshal stability test and tensile strength test considered as a design and evaluation of bituminous paving mixes . The mechanical property of these material will be check whether it is good or bad for bituminous concrete .Ceramic waste and rise husk ash is a good replacement for medium and small traffic roads.

Keywords - Environment marshal test ceramic waste rise husk bitumen concrete mix

I. INTRODUCTION

1.1 General

In this modern era it is very necessary to reduce the budget of any structure without compromising strength and safety .Due to the increasing the cost of road construction, researchers should find an industrial by- products or waste materials to use a substitute for natural resources of material or better mix design for those material to increase the pavement service life and reduce cost . Roads are necessary for the transport of the passengers and goods. Roads are important infrastructure for any country. The construction of roads direct impact on the economy of a nation. Roads are vibrant for the transport of the passengers and goods. So there is need to take a holistic approach and mark the areas where these are most suitable. Infrastructure is a direct index to measure the development of a Country and Road Infrastructure is the costly aspect to boost and promote transportation and economic development. The importance of roads can be compared to that of growth of a nation. Roads performance essential part

in Socioeconomic Improvements, Improved life standard and Employment Opportunities. Roads are much important than Railways owing to the circumstance that they connect to door to door end users directly to the destination. Road transport enable the Transportation Segment to subsidize 4.9 % towards GDP of India. Building Roads involves huge capital expenditure and manpower, thus it is also of utmost importance that they are well planned, designed and constructed for a long period. Roads can be classified in to two categories based on the materials and their design approach –

Flexible Pavement

Rigid Pavement.

Bitumen used in flexible pavement It is a very simple and most convenient type of road construction materials. In however the conventional bitumen performance or application may not be change acceptable because of the curtains reasons are given below: In summer season temperature become very high, so bitumen become soft and due to this draining and separation reason,it is disaster of the flexible pavement. In winter season temperature become very low and bitumen become brittle. In rainy season water enters in to the pavement due to this making pot holes or sometime removing the whole layer of flexible pavement. In hilly region according subzero temperature, the freeze-thaw-cycle according due to ice melting and freezing this reason ice in bituminous voids are expanding and contracting according into the pavement and its make a reason the failure of the pavement. Based on recent investigations and research on bitumen properties (e.g. Viscoelasticity, moisture susceptibility and temperature susceptibility) it is established that moisture resistance can be improving by adding chemical and adhesive for modification of the flexible pavement. Rigid Pavements.

1.2 Flexible Pavement

Flexible pavements are recommended in the India because India is a developing country and sources of funds is not easy to survive ,so that mainly used to construction of flexible pavement.it is a made up of bitumen or asphalt material. A flexible pavement is made up of different materials in different layers. Load is transfer from one layer to another layer in flexible pavement. Individually layer collects the loads from the above layer, distribute them and then allow these loads to the next layer below. different course of the pavement given below.

a) **Surface course:** This is the top layer of bitumen coarse and the layer that comes in contact with vehicle and environmental force .the upper most layer is an asphalt pavement. It may be consist of one or several different HMA sub-layers.
b) **Base course: ,**A base course consist of compacted aggregates,cement or asphalt stabilized aggregate. this is the layer right below the HMA layer..
c) **Sub-base course:** This is the layer (or layers) under the base course layer. A sub-base is not always needed.
d) **Sub-grade course:** The sub level is the material on where the asphalt structure is placed. The sub grade course is the typically the natural soil as well as chosen particle size aggregate which is compacted to specific levels to relatives stress from the weight of the above course. The requirement of soil sub grade is to be minimum changes in volume and stability under adverse conditions of weather and ground water. The CBR estimation of the sub level material is by and large used to outline the aggregate asphalt covering thickness according to IRC: 37-2012 rules.

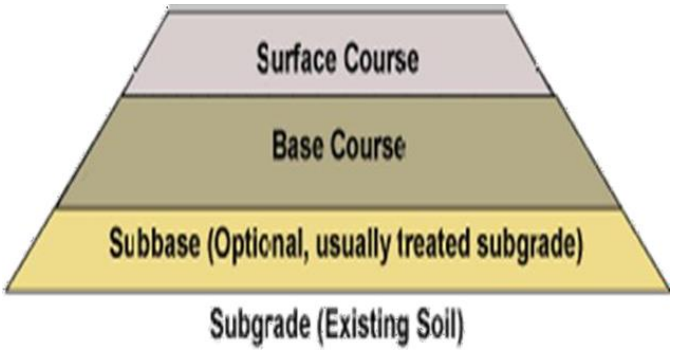

Figure 1.1 Different layers of the Flexible Pavement Section

An adaptable asphalt structure is ordinarily made out of a various layers (as appeared in figure no 1.1) of material with better quality materials on topmost. where the force of physical and environmental force on it, . Flexible pavements can be studies as a multi layer system under loading and are constructed by using various layers such as Bituminous concrete (BC), Dense Bituminous Macadam (DBM), Bituminous Macadam (BM), Wet Mix Macadam (WMM) and Granular Sub base (GSB) as per the MORTH specifications with the designed thickness as per the IRC: 37-2012 have shown figure.

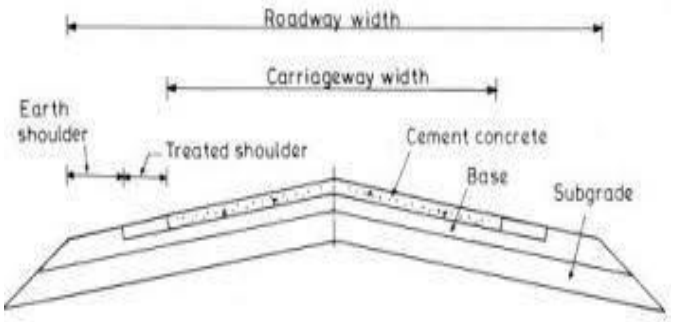

Figure 1.2 Section of Flexible Pavement designed as per IRC: 37-2012

1.3 Bituminous Mixes for Flexible Pavement Layers

Design of bitumen-aggregate mixes for the different layers mostly consists of the following procedure:

- Selection of the type and gradation of the aggregates.
- Selection of the type and grade of binder.
- Selection of the amount of binder to fulfil the specific demand requirements for mix properties.

The properties of bituminous contents can be enhanced, making it more sturdy, practical and considerably more economical by including polymers, plastics and different added substances. Different types of alterations of the physical properties of bitumen and dependability of bituminous blends can be utilizing diverse materials like scrap plastic waste, squander plastics, rice husk ash debris, mineral fillers, fly cinder, e-waste, SBS, Nano SiO2 and other distinctive kinds of polymers.

1.4 Bituminous Concrete mix

Bituminous Concrete should comprise of aggregate and appropriate binder cover, blended in a hot blend plant and mix and transport with a motorized paver machine for transportation on the site. It is an open reviewed blend reasonable for base course. It is laid on a sub base course or in various layers on a formerly arranged base. Depth of the single coat should be 50 mm to 100 mm. Since the bituminous macadam is an open-evaluated blend there is a potential that it might trap water or dampness vapour inside the asphalt framework. Thus, giving effectual seepage outlet to the layer ought to be considered to avoid dampness provoke harm to the BC and consequent bituminous layers.

1.5 Specifications for Bituminous mix

1.5.1 Bitumen

Bitumen is a "A viscous fluid, or a strong, Containing Basically of Hydrocarbons and their , which is dis solvable in tri chloral ethane and is considerably non- unpredictable and changes physical property step by step when it warmed. It is black or brown d in color and has waterproofing agent. It is acquired from refinery from crude oil,

and is additionally found as a part of normally happening black-top of pavement.

Table 1.1 Selection Criteria for Viscosity –Graded (VG) Paving Bitumen Based on Climatic Conditions

Lowest Daily Mean Air Temperature, °C	Highest Daily Mean Air Temperature, °C		
	Less Than 20°C	20 to 30°C	More than 30°C
More than -10°C	VG-10	VG-20	VG-30
-10°C or lower	VG-10	VG-10	VG-20

Applications:

VG-10BITUMEN:

VG-10 is generally used as a part of showering applications, for example, surface-dressing and clearing in extremely frosty atmosphere. It is like used to fabricate bitumen emulsion

VG-20BITUMEN:

VG-20 is used for paving in low temperature & hilly regions

Property	Test	Requirements	Test Method
Cleanliness	Grain size Analysis	Max. 5% passing 0.075 micron	IS:2386 Part I
Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Strength	Los Angeles Abrasion Value Aggregate Impact Value	Max 35% Max 27%	IS: 2386 Part IV IS: 2386 Part IV
Specific Gravity	Specific Gravity	2 - 3	IS:2386 Part III

VG-30BITUMEN:

VG-30 is primarily used to build extra heavy-duty Bitumen pavements that necessity to tolerate substantial traffic loads

Coarse Aggregates

The Coarse aggregates should consist of smashed shake, pulverized rock or other hard material held on 2.36 mm strainer sieve. It might be spotless, hard, solid and cubical shape, free from soil dust, clean and delicate natural and different harmful substances. The total should fulfil the physical necessities of Table and where pounded rock is proposed for use as totals, at the very least 95 percent by weight of the squashed material held on the 4.75 mm sifter might have no less than two broke countenances. Before accumulation of the source, the totals might be tried for accumulation. Where the Contractor's chosen wellspring of totals have poor fondness for bitumen, as a condition for the agreement of that source, the bitumen should be treated with affirmed against stripping operators, according to the producer's suggestions, without extra instalment.

Table1.2 Physical Requirements of Coarse Aggregate for Bituminous Concrete [MORTH, Clause 507.2.2]

Property	Test	Requirements	Test Method
Cleanliness	Grain size Analysis	Max. 5% passing 0.075 micron	IS:2386 Part I
Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Strength	Los Angeles Abrasion Value Aggregate Impact Value	Max 35% Max 27%	IS: 2386 Part IV IS: 2386 Part IV
Specific Gravity	Specific Gravity	2 - 3	IS:2386 Part III

1.5.1 Fine Aggregate

Fine aggregates should comprise of pulverized of stone or normally eassy to excess material,or a blend of the two, passing 2.36 mm sieve and held on the 75-micron sieve. They should be, hardness property, tough, dry and free from tidy, and delicate or friable issue, natural or different harmful cause.

1.5.2 Aggregate Grading and Binder Content

When tested in accordance with IS: 2386 Part 1, the combined grading of the coarse and fine aggregates and added filler for the particular mixture should fall within the limits shown in

Table, for Bituminous concrete mixture grading 1 or 2. The type and quantity of bitumen, and appropriate thickness, are also indicated for each mixture type.

Table1.3 Gradation of Bituminous Concrete [MORTH, Clause 507.2.5]

Grading	1	2
Nominal Aggregate Size	19 mm	13.2 mm
Layer thickness	50 mm	30-40 mm
IS Sieve (mm)	Cumulative % by Weight of total aggregate passing	
26.5	100	
19	90-100	100
13.2	59-79	90-100
9.5	52-72	70-80
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen context % by mass of total mix	Min 5.2*	Min 5.4*

Additives in the Bituminous Mixes

According to announced ceramic enterprises of India progress toward becoming expand step by step which is grasped of divider and floor tiles,ceramic material, clean product, blocks and rooftop tiles, recalcitrant materials and artistic waste materials for local and others utilize is creating around 15 to 31MT for each annul squander.

The territory of Rajasthan and UP monetary explanation for around 75% of aggregate clay manufacture in India and whole of these entire creation 35% goes as disposed of and discarded in the open spaces.The diversify benefits of utilizing ceramic waste powder in road development as mineral filler and as total may be:

- Economic cost is low.
- Physical and chemical properties will be unfaltering.
- Road development movement ways to deal with end up green and eco-friendly.
- hard, and impervious property to substance, organic and physical corruption powers.

White Marble chips

Marble chips are contained of calcium carbonate, which is a soluble composite material. As it is soluble, it reacts with hydrochloric corrosive to create calcium chloride, water and carbon dioxide. Calcium chloride is white, carbon dioxide and water are lackluster. This chips found in various size 2mm,4mm,8mm,12mm.it is moat popular landscaping stones, High lumps of white marble break in process as a small chip, then clean it dry form. and uses it for various purposes in different condition like aesthetic and artistic looks. This white marble chips used as a fine aggregate in this study. White marble chips with the physical and chemical properties are given below. White Marble Chips was accumulated from the available manufacturing unit in Makrana Rajasthan, India

FIGHURE.1: White Marble Chips

Table 1.4: Physical and Chemical Properties of White marbles chip

Physical properties	
Appearance:	White solid
Odour:	Odourless.
Chemical properties	
Solubility:	Negligible (< 0.12%)
Specific Gravity:	2.87
pH:	8 – 10
Calcium Carbonate	85- 100%

Ceramic waste powder

CW can be used as a part of bitumen to enhance its quality and other factors. It is assessed that 15 to 30% squanders are created of aggregate crude material used. The ceramic waste was collected from the locally accessible assembling unit in rajasthan, up in India.

specific gravity of ceramic waste powder is 2.65 and water retention is 2.40%.

Table 1.5 Chemical Properties of Ceramic Waste powder

S.No.	Materials	Ceramic Powder (%)
1	SiO_2	61.29
2	Al_2O_3	19.29
3	Fe_2O_3	4.32
4	CaO	4.46
5	K_2O	3.18
6	Na_2O	0.77
7	MgO	0.67

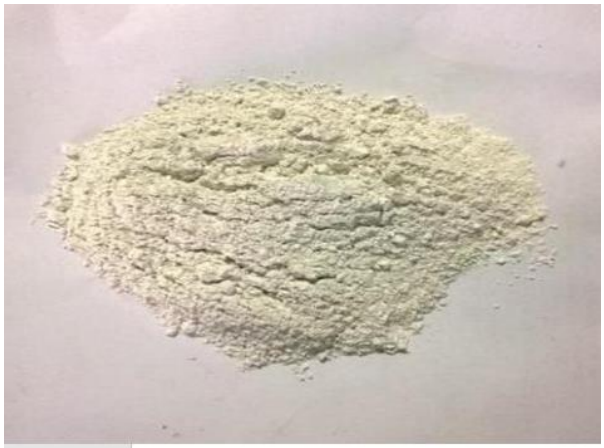

Figure 1.4 Ceramic Waste Powder

(1) Rice Husk Ash

Rice processing industry produces a big amount of husk by processing of paddy which originates from the agriculture. This rice husk.used for make a product like as solid fuel ,carbonized Rice huskand remaining part used as energy production.. Rice husk burning leftovers (RHA) is about 22% by bulk of rice husk when disbursed in boilers. It is measured that 75 million tons of RHA is brought each year around the world. This RHA is an incredible situation danger making harm the land and the encompassing zone. The Rice Husk Ash found from the locally accessible assembling unit in eastern UP, , India.

This item can be consumed as a part of an assortment of uses like:

- green cement
- elite cement
- stubborn
- fired coating
- separator
- material shingles
- waterproofing chemicals
- oil slick permeable
- claim to fame paints
- fire retardants
- bearer for pesticides

Figure 1.5 Rice Husk Ash

Table1.6 physical properties of RHA

Sr no	particulars	properties
1	Colour	Gray
2	Shape texture	Irregular
3	Mineralogy	Non crystalline
4	Particle size	<40 micron
5	Odour	odourless
6	specific gravity	2.35
7	Appearance	Very fine

Table1.7 chemical properties of RHA

Sr no	Particulars	proportion
1	Silicon dioxide	84.94%
2	Aluminium oxide	.2%
3	Iron oxide	.1%
4	Calcium oxide	03.-2.2.%
5	Magnesium oxide	0.2 -0.6%
6	Sodium oxide	0.1%- 0.8%
7	Potassium oxide	3.15-4.30%

II. SCOPE OF STUDY

Determination of mechanical property and optimum bitumen content of mixtures based on Marshall test.in this study, series of tests specimens were prepared with a range of different bitumen contents were prepared for the determine optimum bitumen content.

To study of bituminous concrete with the addition of ceramic waste material and RHA

III.CONCLUSION

Now the day roads like NH, SH and major urban roads and sub major roads possess the bituminous concrete at the top and necessity of filler aggregates . Mostly cement, fine dust or lime are used as a filler content. As agricultural by-products Rice husk ash and ceramic waste powder produces as a waste material in the huge quantity in industries .it require to disposal of such waste material. The alternate option is to use it in construction industries.

IV. REFERENCES

[1]. IRC 37-2001 “Guidelines for the Design of Flexible Pavement”The Indian Roads Congress, New Delhi, 2001.

[2]. IS 73: 2013 PAVING BITUMEN — SPECIFICATION

[3]. IS 2386-1963: (Part 1-6) “Methods for test on aggregates” The Standard, New Delhi, 1963.

[4]. IS: 1201-1220.1978 “Methods for Testing Tar and Bituminous Materials (First Revision)”The Indian Standard, New Delhi, 1978.

[5]. MORT&H "Specifications for Road and Bridge Works" (Fifth Revision).

[6]. Haroon lattef khan (Mewar university Chittogarh) and avinash kumar (Asst. Prof, H O D civil engg.) (2015)-Density based experimental analysis of Geo synthetic material application of road construction_International Journal of Science and Research (IJSR)

[7]. G Venkatappa Rao and P K BANERJEE (IIT, DELHI) (1997) -GEO SYNTHTIC ; RECENT DEVLOPMENT - INDIAN JOURNAL OF FIBER AND TEXTILE RESEARCH

[8]. Ashwini rajshekhar amashi - (assistant prof) deprtment of civil engg D. Y.P I E T AMBI PUNE, (2019) - A review on application of Geo - synthetic and cost benefits analysis in construction of roads -International journal of research in advent technology, special issue ICIMCE 201

Cite this article as :

Sameer KR. Kushwaha , "Experimental Investigation of Bitumen Concrete mix with Use of Ceramic Waste and Rise Husk Ash as a Partial Replacement of Filler and Aggregate", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 10 Issue 3, pp. 379-385, May-June 2023. Available at doi : https://doi.org/10.32628/IJSRST52310383
Journal URL : https://ijsrst.com/IJSRST52310383