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Use of Ceramic Waste in Flexible Pavement

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Abstract:

India is the 2nd largest road networks among the globe with 5.9 millions of kilometers and these all are laid with natural aggregates, fine aggregates and bitumen and the bitumen which suits to the temperature and weather conditions. There are many materials which we can use them as filler material on behalf of stone dust materials like plastic waste, ceramic waste, palm oil ash, crumb rubber. I choose ceramic powder which we can get more waste material from the tiles companies they will use only 30% of the material in 100% the remaining 70% is getting dumped on the surface or into the ground this can pollute the soil and water the chemicals can become harmful instead of dumping the waste we can use that waste as our filler material for partial replacement in laying of flexible pavement. This is economically low and we can reduce the dumping problems.

Keywords:*Ceramic Waste, Bituminous Macadam, Marshall Mix Design Etc.*

I. INTRODUCTION

In India, road transport is must in the daily life without road we cannot even travel anywhere for a long distance the roads should be laid for everywhere in the city or to a village (4). For this the government is sanctioning some funds for laying of roads even though the road quality is not good there are many reasons like insufficient funds, for this I got a solution with this we can have a good quality of roads and this will reduce the costs and the funds which are sanctioned by the government will be sufficient (5). Usually we are laying the pavement by using natural aggregates, fine aggregates and bitumen with different grades which will suits the temperature and weather conditions for reducing costs now I, am going to use c.w as replacement material in pavement as the replacement of stone dust this will be cost effective and we can have a good quality of pavement more than a normal pavement. The ceramic waste we are getting from the tiles company they will produce 100% of the product they will use only 30% of the ceramic and the remaining 70% is totally waste they are dumping on the surface or into the ground this will pollute the soil and water with the chemicals which are used for that so we can solve that problem by taking that waste and we can use that waste in an effective manner for laying of pavement. This has many good properties which can have good binding nature, strength, durability etc. This ceramic waste has many chemical properties in it in that case this can attain maximum strength. I used bituminous macadam table for the laying of pavement. I have to test it before going to the laying of road. The bituminous macadam contains the percentage of bitumen content like 4, 4.5, and 5%. Why all will use stone dust as filler material? There are many filler materials which can attain the strength and durability etc. ceramic waste is one of the filler material which we can easily get lots of tons over the world. Asphalts are one of the principle segments of our transportation and foundation frameworks. Smooth, agreeable and all around kept up asphalts for roadways, runways and so on are normal by a country, however are significant for security of vehicle developments, feel of scene and monetary, social and social improvement of any nation. In present day days

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because of immense increment in rush hour gridlock load, adequate great quality is vital for various layers of asphalt. Contingent on the nature and method of burdens to be upheld and conveyed, asphalts are named adaptable, semi-adaptable and unbending, however the basic normal segment of every one of these sorts is bituminous layer. (Most of this is written on my own)

Fig 1: ceramic waste

II. Literature Survey

A stoneware is inorganic, non-metallic solid orchestrated by movement of warmth & coming about cooling. Stoneware materials will have a crystal or to some degree crystal shape, or may be the vague (for instance a glass). Since most customary ceramic creation are crystal, the importance of pottery is regularly restricted to inorganic crystal materials, as opposed to the non-crystal glasses, a capability followed here. According to Zephaniah (2008) the most prompt pottery creation made by individuals were ceramic articles, including multi year old manikins, delivered utilizing mud, either without anyone else or it is mixed in with various types of materials, forged in fire. Later ceramic creation were covered and ended to make a tinted, smooth surface. Ceramic creation by and by fuse private, mechanical and building things and a wide extent of terminated workmanship. In the twentieth century, new pottery materials were made for use in front line creative planning; for example, in semiconductors (Dennis, 2009). (6)

Thing from the ceramic creation industry contains the going with: divider and floor tiles, clean item, squares and housetop tiles, difficult materials, specific pottery creation and aesthetic materials for family unit and ornamental use. In the European Union and Spain, the making of divider and floor tiles addresses the most raised rate concerning the total, trailed by squares and housetop tiles, likewise, various things. Terminated things are conveyed from ordinary materials having a high degree of earth minerals. Following a methodology of drying out and controlled ending at temperatures some place in the scope of 700ºC and 1000ºC, these minerals get the trademark properties of ended earth.

i.Experimental Study

3.1 *Tests on aggregates*

1. Impacttest
2. Crushing test
3. Flakiness and Elongation index
4. Specific gravity & water absorption test

3.2 *Tests on bitumen*

1. Penetration test
2. Softening point test
3. Flash and fire point test
4. Ductility test

ii.Analysis and Results

1. Bitumen

Bitumen containing Viscosity Grade (VG-40) is used as a cover in the investigation done. The vital trial of bitumen are surveyed by IS 73:2013 and the outcomes accomplished are

TABLE 1

s.no	Test	Result	Requirements as per IS 73:2013
1	Penetration test	69	50-75

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2	Softening point	48	47-57
3	Ductility test	89.5	Min 7.5
4	Flash point	255	Min 220
5	Fire point	292	Min 220

2. Aggregates

Aggregates are sieved as per bituminous macadam and proportioned as required and the aggregates used are coarser and finer in size. The following tests are conducted mention in this table.

TABLE 2

S no	Test		Results	Test conducted as per	Requirements As per Morth v, revision
1	Aggregate impact test		28.1	IS 2386	Max 35%
2	Los angles abrasion test		31.45	IS 2386	Max 40%
3	Flakiness index		12.3		Max 15%
4	Elongation index		17.6		Max 20%
5	Aggregate water absorption		1.8	IS 2386	Max 2%
	Corse	2.26			
	Fine	2.2			

3. Ceramic waste

Ceramic waste comes from the tiles and ceramic companies or industries near Gudivada, Andhra Pradesh, India (4).

TABLE 3

S.No	Property	Value
1	Sp.gravity	2.2
2	Color	Random
3	Particle size	75µ-2.36mm

The composition of ceramic waste as follows

TABLE 4

Particular materials	Ceramic Powder%
SiO_2	63.29
AL_20_3	18.29
Fe_2O_3	4.32
Ca O	4..46
K_2O	2.18
Na_2O	0.75
Mg O	0.72

4. Aggregate Gradation

Degree of totals is fundamental so as to get solidness since it is dependent on it. Bituminous blend Stability is expanded with an abatement in air voids. Total degree for bituminous Macadam is picked according to Table 500-19 of MORTH (V Revision) and is posted beneath (10).

TABLE 5

S no	Sieve size	% passing
1	45	-
2	37.5	-
3	26.5	100
4	19	90-00
5	13.2	56-88
6	4.75	16-36
7	2.36	4-19
8	0.3	2-10
9	0.075	0-8

5. Marshall stability

To know the Stability, Flow of the bituminous concrete mix using ceramic waste and Stone Dust, Marshall test is carried out. These tests were carried out by replacing ceramic waste as Filler material in replacement of stone dust for bitumen percentages of 4%, 4.5% and 5%.

The required specifications of Marshall as per MORTH (V Revision) of Table 500-10 are (9)

TABLE 6

Property	Value
Stability	Min 900
Flow	2 - 4
Air Voids	3 – 6
Voids Filled with Bitumen(vfb)	65 – 75

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Voids in Mineral Aggregates(vma)	13 – 15

Optimum Bitumen Content (OBC) is the normal bitumen content at most extreme solidness, maxmium mass thickness, and at 4% air voids.
Marshall Properties of bituminous mix are determined. The results obtained at 4%, 4.5%, 5% bitumen content with using fillers as Stone Dust and CW are presented in the given figures below.

TABLE 7

Bitumen	Stability	Flow	V_v	VFB	VMA	Density g/cc
4	1510.1	3.2	4.81	66.7	13.6	2..49
4.5	1570.4	3.46	4.63	69.1	14.1	2.58
5	1494.6	3.81	4.12	72.4	14.7	2.53

Marshall Properties of Specimen with Stone Dust as Filler Material

TABLE 8

Bitumen	Stability	Flow	v_v	VFB	VMA	Density g/cc
4	1525.56	3.28	4.92	67.1	13.8	2.56
4.5	1594.15	3.54	4.71	69.6	14.5	2.62
5	1559.7	3.96	4.25	74.2	14.7	2.54

Marshall Properties of Specimen with ceramic waste as Filler Material

The following graphs are plotted

i. Bitumen. quantity (%) vs Stability (kg)
ii. Bitumen. quantity (%) vs Flow (mm)
iii. Bitumen.Quantity (%) vs Air Voids (%)
iv. Bitumen.quantity (%) vs Density (g/cc)
v. Bitumen.quantity (%) vs Voids Filled With Bitumen (%)

Figure 2: Bitumen Content vs Stability

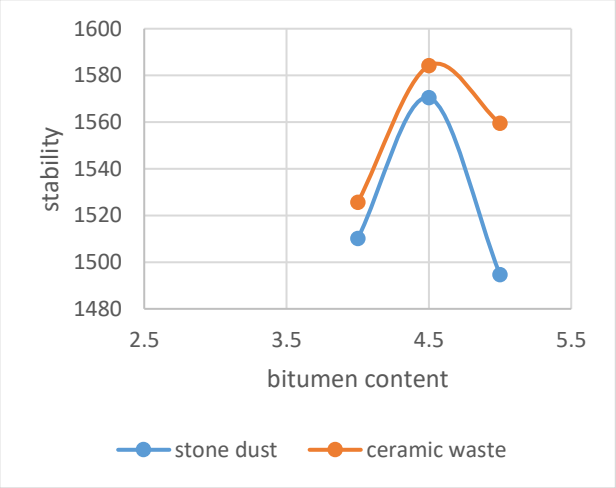

Figure 3: Bitumen Content vs Flow

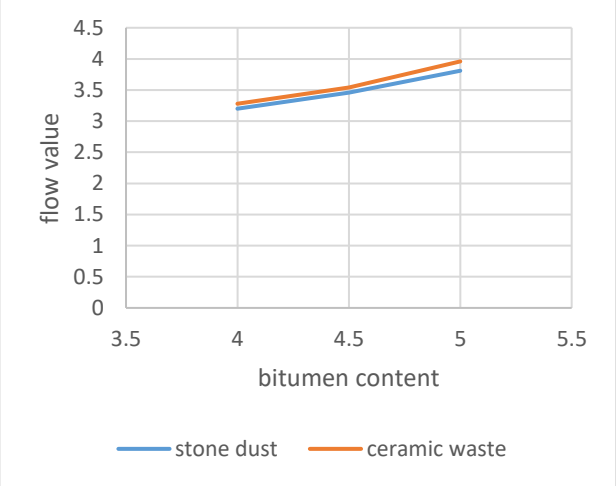

Figure 4: Bitumen Content vs Air Voids

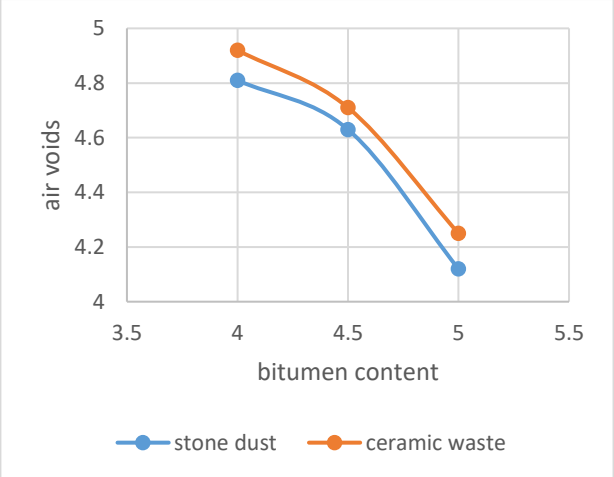

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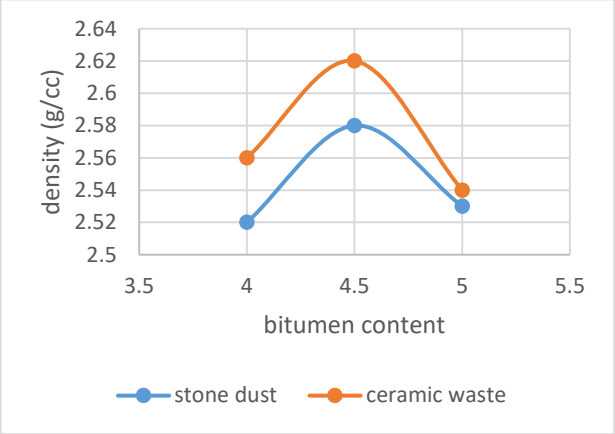
Figure 5: Bitumen Content Vs Density



Comparison of results obtained using Stone Dust and ceramic waste at OBC:

Properties	Stone dust	Ceramic waste
OBC, %	4.54	4.59
Stability, kg	1558.36	1560.1
Flow, mm	3.49	3.59
V_v, %	4.52	4.62
VFB, %	69.13	70.33
VMA, %	14.13	14.33

III. Conclusion and Recommendations

1. The results indicate that stone dust and ceramic waste have similar properties and we can replace ceramic waste in the place of stone dust.
2. By using ceramic waste as filler material we can solve the dumping problems and pollution will be reduced and reduces the cost of the pavement.
3. This materials are available in tons so we can get lot of material and there are many materials we can use as filler material.
4. We have to focus on the other materials too for the safe environment.

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