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Use of RHA As Filler In Bituminous Concrete

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Abstract: This paper summarizes the ongoing researches approximately Use of RHA as mineral filler in h bituminous concrete . Many researches regarding the addition of filler have been laid down with the aid of special students. Many research concerning the addition of OPC and waste substances like cement kiln dust,lime and rice husk ash have been studied and then their results have been additionally analyzed and laid all the way down to a proper end. It turned into concluded that through use of different types of fillers increase the existence of pavement, expanded marshal balance values, decreased pavement deformation, growth fatigue resistance, provide better adhesion among asphalt and aggregates and growth in sturdiness of bendy pavement.
In this look at, it was investigated to apply of the RHA inside the bituminous concrete as mineral filler in vicinity of conventional filler.

Key Words: Rice husk ash, lime, marshal stability test, stability value and flow Characteristics, flexible pavement, hot mix asphalts.

I. INTRODUCTION

The nice of roads dictates the economic system of a rustic and for this reason the first-rate of our lives. Roads are crucial for the transport of the goods and passengers. In India, road shipping carries approximately 85% of passenger traffic and 70% of freight shipping. But the development of highways includes big amount of the investment and particularly sixty percent of the highway assignment price is related to the pavement creation. Pavement is a long lasting surfacing of a street, airstrip, or comparable region and the primary feature is to transmit masses to the sub-base and underlying soil sub grade. Around ninety percentage of the Indian Highways have a protected surface with bituminous layers which can be constructed and maintained through the usage of evidently to be had avenue aggregates and bitumen, a petroleum product, which being combined at high temperatures to produce warm blend asphalt. Mix design for the distinctive layers of the pavement will have a main effect at the overall performance, price and sustainability of the bituminous surfaces. The want hence arises in making comprehensively green bendy pavements that may function an asset to the economic system of a country. In India, various strategies have been put forward within the subject of motorway engineering. There is for this reason an outmost urgency in bringing approximately extra new thoughts in this factor in order that a kingdom that is structured mostly on its highways may pursue toward a higher the next day.Bituminous concrete shall be used as a carrying direction & shall now not be laid directly over WBM or any granular base. The shall consist of mineral aggregates and appropriate binder mixed in a hot blend plant and laid with a paver on a previously organized base in accordance with the specification and confirming to the lines , grades and cross sections. Rice husk is one of the primary agricultural residues received from the outer overlaying of rice grains for the duration of the milling technique. It constitutes 20% of the 500 million tons of paddy produced within the world. It's an agriculture waste and while waste are to be burned and to depose it in land filling, it's not a ecofriendly tactics as they pollute the land and the air. RHA is a highly pozzolanic fabric, contains silica and surface specific area. That's why some of the area in civil engineering it's being used in soil engineering and in toll road production in flexible pavements as mineral filler. It is located that RHA is a highly pozzolanic fabric carries greater % of silica, its rich in amorphous silica approximately 86% in RHA in this have a look at.Filler play vital position in property of bitumen blend, Fillers will increase the stiffness of the asphalt mortar matrix. Fillers also have an effect on workability, moisture resistance, and growing older characteristics of HMA mixtures. Different sorts of mineral fillers may be used inside the HMA mixes together with stone dust, ordinary Portland cement (OPC), slag, fly Ash, hydrated lime and rha etc.

II. Function of different highway materials

Following materials are used in bitumen mix

II.I. Fine Aggregates

Fine aggregates for bitumen mix consists of crushed or naturally occurring mineral material or a combination of the two, passing the 2.36mm Indian standard sieve and retained on the 75 micron Indian standard sieve. Aggregates should be clean, hard, durable, and free from dust, dry and soft or friable matter, organic or other deleterious matter.

II.II. Coarse Aggregates

The coarse aggregates for the SDBC mix consists of crushed rock, crushed gravel or other hard material retained on the 2.36mm sieve. The aggregates should satisfy the physical requirements as specified in table, see Table 1 (Ref: MOSRT&H Specifications for Road and Bridge Works for Semi Dense Bituminous Concrete).

II.III. Bitumen

The bitumen for the paving bitumen of penetration Grade complying with Indian Standard Specifications for "Paving Bitumen" In our study VG30 grade bitumen with 60- 70 penetration grade bitumen is used throughout the study. (Ref: MOSRT&H 508.2.1.) Specifications for Road and Bridge Works for Semi Dense Bituminous Concrete IS-73 2006)[4].

Table -1: Section 500 Table 500-14[2] Physical Requirements for Course Aggregate for Bituminous Concrete Pavement Layers
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Descriptiontest	Specification as 'MORTH'	Test method	Test result
1.Aggregate crushing value %	Max. (10-25) %	**IS** – 2386 P(IV)	14.90
2.Aggregate impact value %	Max. (27) %	**IS** – 2386 P(IV)	17.55
3.Loss Angelis abrasiontest %	Max. (35) %	**IS** – 2386 P(IV)	15.12
4.Water absorption test %	Max. 2 %	**IS** – 2386 P(IV)	0.162
5.stripping	Max. Retained coating (95%)	**IS** – (6241-1971)	98 %
6.Flakiness index %	Max. 15 %	**IS** – 2386	14%
7.Elongation index %	Max. 15 %	**IS** – 2386	13.5%
8. SPECIFIC GRAVITY		**IS** – 2386	*2.75* Avg.

Figure 1 Gradation of aggregate sample

Table -2: Gradation of stone Aggregate for bitumen mix as per MORTH Specification

Grading	1	2
Nominal aggregatesize	13 mm	10 mm
Layer thickness	35-40 mm	25-30 mm
IS Sieve1 (mm)	Cumulative % by weight of total aggregate passing	
37.5	-	-
26.5	-	-
19	100	-
13.2	90-100	100
9.5	70-90	90-100
4.75	35-51	35-51
2.36	24-39	24-39
1.18	15-30	15-30
0.6	-	-
0.3	9-19	9-19
0.15	-	-
0.075	3-8	3-8
Bitumen content % by mass of total mix	Min 4.5	Min 5.0

Grading of bitumen mix as per 'MORTH'						
Sieve size (mm)	10 mm (A)	6 mm (B)	Dust mm (C)	Filler (D)	0.39A+ 0.27B+ 0.32C+ 0.02D	'MORTH' Specified
13.2	100	100	100	100	100	100
9.5	91.7	100	100	100	96.763	90 - 100
4.75	19.2	31.6	100	100	50.02	35 – 51
2.36	1.2	16.5	78.5	100	32.04	24 – 39
1.18	0.5	3.5	54.5	100	20.58	15 – 30
300 µ	-	0	22.5	100	9.28	9 – 19
75 µ	-	0	4.0	95	3.18	3 - 8

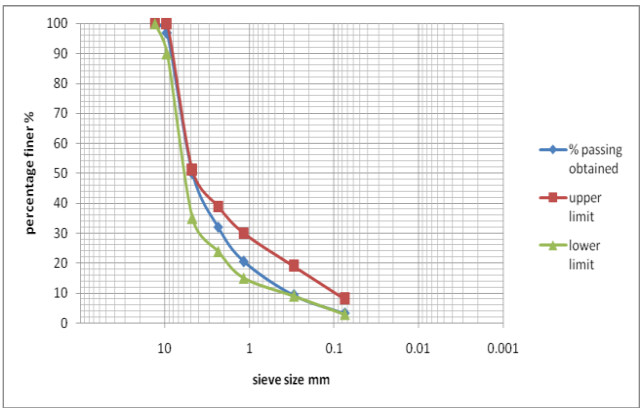

Figure 2 Gradation curve (sieve analysis of Aggregate)

Table-3: Test result in laboratory of the Bitumen usedthroughout the study:

SR. No.	Description	Test Method	Test Result	Remarks
1	Specific Gravity	IS 1202	1.025	-
2	Penetration	IS 1203	60.5	60/70 grade Bitumen
3	Softening Point	IS 1205	55^0 C	-
4	Viscosity at 135 ^{0}C	IS 1206	380 cst	-
5	Ductility	IS 1208	92.2	-

II.IV. Filler

Fillers have plays a full-size role at the residences of HMA mixtures specifically in terms of air voids, voids in mineral mixture. Fillers growth the stiffness of the asphalt mortar matrix. Fillers additionally affect workability, moisture resistance, and getting old characteristics of HMA combos. Different types of mineral fillers may be used within the HMA mixes such as stone dust, normal Portland cement (OPC), slag, fly Ash, hydrated lime and RHA and so on.

Rice husk is one of the major agricultural residues obtained from the outer overlaying of rice grains at some stage in the milling method. It constitutes 20% of the five hundred million tons of paddy produced inside the global. It's an agriculture waste and while waste are to be burned and to depose it in land filling, it's no longer a ecofriendly techniques as they pollute the land and the air. See Table-4 The chemical composition of typical rice husk ash.

The rice husk ash as filler in bituminous mixes the possibilityof using Rice husk ash –a waste product from rice as a filler material in bituminous mixes. The marshal design criteria are used to establish its suitability.

Figure4. Raw RH & (b) Burnt RHA

Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer. The useof RHA should be encouraged because of its very good anti-stripping and antioxidant properties.

Table-4**:** The chemical composition of typical rise huskash is as follows:

Chemicals	%
Silicon dioxide (SIO_2)	86.66
Aluminium, oxide (AL_2O_3)	2.48
Iron oxide (FE_2O_3)	1.10
Calcium oxide (CAO)	1.75
Magnesium oxide (MgO)	1.08
Carbon dioxide ($9CO_2$)	0.51
Loss on ignition	3.80
Potassium (K_2O)	1.4
Sodium (NA_2O)	0.1

III. Status of ongoing researches

Although many researchers have studied the outcomes of RHA in concrete combos however very little study has been a done to make use of RHA into bitumen combinations.

III.I. RHA in Asphalt Concrete

During the last few decades the developments on the analysis of asphalt mixes with RHA is developed.

S.C.Sexena, et al (1984) Studied the upward rice husk ash as filler in bituminous mixes the opportunity of the use of rice husk ash - a waste product from rice - as a filler fabric in bituminous mixes. The Marshall Design standards are used to set up its suitability. In the real experiments diverse percentages of wealthy husk ash as a filler are used with unique bitumen contents. The different preferred fillers - cemented rock dirt-were extensively utilized as comparisons in getting ready the samples.

The optimum filler and bitumen contents enjoyable the Marshall Design standards are obtained for all three kinds of fillers used. The results received from rice husk ash are quite encouraging and the paper suggests in addition regions for studies in this field. The results of this research, indicate that rice husk ash can efficaciously be used as a filler in bituminous mixes because the consequences obtained are quite comparable with the ones the use of cement or rock dirt as a filler. For the unique type of grading used for this studies 4 per cent (4%) of rice husk ash is considered as most advantageous with 6.5 consistent with cent of 80/100 grade of bitumen.

J. E. Edeh et al (2012) Stated a laboratory evaluation of the characteristics of rice hush ash (RHA) stabilized reclaimed asphalt pavements (RAP) subjected to British Standard light, BSL (Standard Proctor) compactive effort to decide the compaction characteristics and California bearing ratio (CBR) values is done. Test consequences show that the homes of RAP stepped forward while treated with RHA, the use of up to 2% cement additive. The particle size grading advanced from one hundred% coarse aggregates for 100% RAP to 10 – 90% coarse mixture with 10 – 90% fines for the various RAP + RHA combos containing up to 2% cement. The CBR values also accelerated from 8 and 14% for the unsoaked and soaked situations, respectively, for 100% RAP content to 73 and 79% (soaked situation) for 89.25% RAP inside the RAP/RHA blend proportions with 1.5% cement/89% RAP content material within the RAP/RHA mix proportions with 2% cement content, with corresponding unsoaked CBR values of 28% and 26%, respectively. Generally, soaked samples recorded higher CBR values than unsoaked samples. The RHA stabilized RAP blend proportions with 89.25% RAP/1.5% cement content material, & 89% RAP/2% cement content material with CBR values of 73 and seventy nine% (soaked for twenty-four hours) may be used as sub base or sub grade substances in street creation.

S.Karahancer, et al (2013) Reported on the use the rice husk ash (RHA) in the hot mix asphalt as mineral filler. For this motive, 4 one-of-a-kind serial asphalt concrete samples are produced using limestone (LS) in unique proportions 2% - 5% as mineral filler. The quantity of ideal bitumen & the fee of Marshall Stability (MS) are decided with MS check for the samples. Choosing the collection of asphalt having 5% filler which has given the very best stability RHA is modified with LS filler in the fee of 25%, 50%, 75%, & one hundred%. After that MS test is performed at the produced samples & the outcomes are evaluated. As a end result, it has come in view that RHA can be used as mineral filler in the asphalt concrete. From the check the observed the highest MS fee has visible on samples organized with 2.5% RHA & 2.5% LS. MS price also extended by means of percent of 2.26 in samples prepared with 1.25% RHA & 3.75 LS.

R. Tomar, et al (2013) studied the effect of fillers on bituminous paving mixes. Construction of highway involves Big outlay of funding. A unique engineering layout can also keep sizeable investment; in addition to dependable performance of the in-carrier toll road may be done. Two things are of principal considerations in this regard pavement design & the combination layout. A good design of bituminous mix is predicted to result in a combination which is adequately sturdy, long lasting & resistive to fatigue and permanent deformation & at the equal time environment pleasant & not pricey. A blend clothier attempts to achieve those requirements via a number of tests on the mixture with various proportions of fabric combos & finalizes the exceptional one. This often includes a balance between collectively conflicting parameters. Bitumen mix layout is a sensitive balancing act some of the proportions of various mixture sizes & bitumen content material. For a given combination gradation, the most reliable bitumen content material is estimated through fulfilling some of blend design parameters. Fillers play an essential role in engineering houses of bituminous paving mixes. Conventionally stone dust, cement & lime are used as fillers. An strive has been made in this research to evaluate the impact of non- conventional & cheap fillers together with brick dust & silica fume in bitumen paving mixes. It has been observed due to this task that bituminous mixes with those non- conventional fillers result in great Marshall Properties even though requiring a chunk better bitumen content material, for this reason substantiating the need for its use. The fillers used in this investigation are probable to in part solve the strong waste disposal of the environment.

M.Jamil, et al (2013) studied the Rice husk ash (RHA) is an established supplementary cementitous material (SCM). Extensive research has been carried out to incorporate RHA as a SCM in casting concrete & mortar. RHA contributes in two fold of effects in concrete or mortar; i.e. filler effect and Pozzolanic effect. Replacement percentages of RHA used in various previous studies are chosen arbitrarily like 5%, 10%, & 20% & so on to determine the total effect of RHA. But the unique filler effect or Pozzolanic effect of RHA in cementitous system is yet to be investigated comprehensively by the scientific community. This study is carried out to find the maximum Pozzolanic (chemical) contribution of RHA in cementitous system in terms of replacement percentage. The determination is analytical & based on the hydration reaction of cement & the Pozzolanic reaction of RHA with the hydration product. This study determines the chemical contribution of RHA on the basis of replacement percentage of RHA. The replacement percentage is determined as approximately 14.3% for ASTM type-I cement with 55% C_3S & 19% C_2S. This percentage can vary with the change of RHA composition or type of cement used. All the results found in this study are theoretical & based on the chemical reactions in the hydration process of cement. Results may also vary depending upon the percentage of C_3S and C_2S present in cement.

Abdulfatai Adinoyi Murana, et al (2014) investigated the partial replacement of cement with rice husk ash (RHA) as filler in asphalt concrete design. This work focused on the use of Rice Husk Ash (RHA) as filler in Hot Mix Asphalt (HMA). HMA design is carried out using Marshall Stability method. Several trial mixes with bitumen contents of 4.5% to 7.5% are produced to obtain the Optimum Bitumen Content (OBC). The investigation focuses on the partial replacement of cement with RHA using the obtained OBC in the following order 0%, 5%, 7.5%, 10%,12.5%, 15%, 17.5%, 20%, 22.5%, & 25%. A total of forty-two (42) mix specimens are prepared, twelve (12) of these are compacted at each percentage of bitumen content to determine the OBC & 30 specimens are used to determine the optimum RHA content in terms of the HMA strength. From the Marshall Stability-flow test

analysis, the sample prepared with 10% RHA as filler with an OBC of 5.5% satisfied the provision of the Standard Specification requirement by Asphalt Institute.

U.H.Onyeiwu, et al (2014) investigated the use of RHA as filler in Asphalt concrete pavement. Asphalt mix design was carried out using Marshall Stability method to test the performance of the materials in terms of its known engineering properties. Several trial mixes with bitumen contents of 4.5%, 5.5%, 6.5% and 7.5% are produced in order to obtain the OBC. This investigation focuses on the partial replacement of the cement by RHA in the obtained OBC in the following order 0 %(control), 5%, 7.5%, 10%,12.5%, 15%, 17.5%, 20%, 22.5%, & 25%. The total 42 mix specimens are produced for the experiment. 12 of these specimens are compacted with each percentage of bitumen content, to determine the optimum bitumen content, and 30 specimens are produced to determine the optimum rise husk ash content in terms of asphalt concrete strength. From the Marshall Stability- flow test & density-void analysis, results obtained show that the performance of mix containing 0%(RHA) control have stability, flow, compacted density of mix, void in mix, void in mineral aggregates, & VFB as 6.7 kn, 3 mm, 1.49gm/cm^3, 39.4%, 47.27% & 16.63% at an OBC of 5.5%. The sample prepared with 10% RHA have stability, flow, CDM, VIM, VMA and VFB of 7.63%, 2.19 mm, 1.78gm/cc, 28.23%, 36.77% & 23.23% respectively at an OBC of 5.5% which satisfied the provision in the standard specification requirement of Marshall criteria by Asphalt Institute (1979).Thus for maximum strength, 10% RHA is recommended as partial replacement of cement as filler in Asphalt Concrete mix.

A.Sadeeq, et al (2014) Provided recycle of Reclaimed Asphalt Pavement (RAP) with Rice Husk Ash (RHA) blends as Filler. Large quantities of agricultural waste are generated every day, and their safe disposal raised an awful lot global concern. The popular trends in the stabilization or modification of construction materials, especially soil, have resulted in innovative techniques of utilizing the solid waste materials. The researcher presents an experimental investigation into the use of Rice Husk Ash (RHA) as filler to replace Ordinary Portland Cement (OPC) in Reclaimed Asphalt Pavement (RAP). Results of preliminary tests on RAP showed that its properties for pavement mix design were below the standard specification for road works. For correction, RAP was reconstituted with fresh aggregate. Rice Husk Ash (RHA) is used as partial replacement for Ordinary Portland Cement (OPC). Marshall Stability tests are performed on various mixes to investigate the pavement performance indices of the blended materials. The most effective combination of mix constituents that meets all design requirements is 70% RAP, 27% fresh aggregate & 3% mineral filler. An optimum value of 25% RHA filler replacement for OPC is obtained. Indirect tensile strength test results indicated that the use of RHA as filler contributes more to crack resistance of recycled asphalt pavement than OPC filler.

B.H.Goh, et al (2014) studied on the experimental results on the utilization of Rice Hush Ash (RHA) as a replacement for mineral filler in asphaltic concrete pavement in Malaysia. Asphaltic concrete mixes containing RHA at different amounts & control specimens were prepared in accordance to Marshall Mix design, and their performance on stability, flow & bulk density are evaluated. Optimum binder content (OBC) & voids analysis are also conducted to compare performance of RHA at different contents. Results reveal that all RHA mixes have satisfied the Malaysian Public Works Department (JKR) specification on wearing course in regard with Marshall Stability & Flow, especially RHA-75. This material is potentially to be used as partial or full substitution of mineral filler (stone dust) in pavement construction.

M.Arabani, et al (2015) studied the laboratory investigation of hot mix asphalt containing waste material. It has been recognized with growing concern that agricultural & industrial wastes are increasingly produced in large volume. In order to reduce environmental hazards & conserve natural resources, the use of waste materials in highway pavements would be extremely effective in terms of recycling waste materials. The main purpose of this study is to investigate the effects of waste materials as filler on the performance of hot mix asphalt (HMA) mixtures. HMA mixtures containing waste glass powder (WGP), waste brick powder (WBP), rice husk ash (RHA) & stone dust (control mixture) was fabricated & the optimum asphalt binder content was determined for each mixture. The properties of HMA mixtures were investigated by Marshall, indirect tensile stiffness modulus & indirect tensile fatigue tests. The results indicated that WGP & WBP mixtures exhibit higher fatigue life & better performance than other mixtures. In addition, it is determined that there was no considerable difference in the performance of RHA mixture & control mixture.

Banerjee, et al (2016) studied the effective way of utilization of rise husk ash in hot mix asphalt. Now-a-days utilization of waste product in construction industry is going on rapidly. One such types of agro-industrial waste product is Rice Husk Ash (RHA), produced abundantly in rice mills from the burning of Rice Husk (RH). In this study RHA has been utilized in Hot-Mix-Asphalt (HMA) concrete in two different ways. Firstly RHA is used in HMA as mineral filler by partial replacement (1%, 2%, 3% and 4%) of Stone Dust which was used as conventional filler. Secondly RHA is used to modify the normal bitumen (80/100) by three different proportions (10%, 20% and 30%) & then these three types of modified bitumen were used to prepare HMA. Now with these two types of mixes Marshall Tests & Fatigue Tests were carried out. The mix in which RHA is used as filler (upto 3%) has shown the similar Marshall stability values as compared to conventional mix but the optimum bitumen content has been increased by addition of more RHA into the mix. Also the fatigue life of this mix is similar up to the addition of 2 % RHA as filler in comparison with conventional mix & then the fatigue life is reduced with addition of more RHA. The second type of mix in which RHA- Modified bitumen is used, had shown higher stability values than conventional mix up to 20% RHA-modification. In this mix the optimum bitumen content is also reduced with 10% & 20% modified bitumen & is similar for 30% modified bitumen. The fatigue life is observed considerably enhanced by the mixes with 10% & 20% modified bitumen but it was less for 30% modified bitumen. So RHA can be effectively incorporated into asphalt mix as bitumen modifier & also as mineral filler up to certain limits.

R. G.N.Yasanthi, et al (2016) studied the performance of waste materials in hot mix asphalt concrete. This study attempts to examine the behavior of Hot Mix Asphalt (HMA) concrete when selected waste materials, namely carbonized wood saw dust, PET & hot mix asphalt waste, are introduced & recommends the suitable replacement percentages. The recommended replacement & addition rates were established by considering the Marshall properties. The results of the study reveal that, the wood saw dust carbonized in oxygen-less condition can be used to replace the traditional filler in HMA concrete upto 2.74% of the total aggregate weight. In this study PET fibers of 30 mm length were used & up-to 2% of the total aggregate weight Marshall Properties showed an increasing trend. In the third part of the study old HMA concrete removed from 2 year old highway is tested suitability. With addition of reduced amount of bitumen satisfactory Marshall Properties were achieved. The cost reductions of 9.5% & 16.6%, compared to HMA made from virgin materials, were achieved in the case of adding carbonized wood saw dust & reusing HMA waste respectively. Cost & the additional bitumen needed for the reusing HMA waste should be based on the characteristics of the HMA waste sample.

IV. CONCLUSIONS

After going through no. Of researches. I conclude that use of RHA as mineral filler in Bitumen mix .Now not simplest improves the satisfactory of mix however additionally help in utilization of waste material called RHA.
The no. Of cases have a look at furnished though out this studies turned into sufficient to assist readers to be familiars with the exceptional era implemented of producing and incorporating fillers in bitumen mix which can be essential in construction of roads with very certified pavements and improved durability and pavement performance.
The take a look at on the usage of RHA as mineral filler in hot blend by replacing the conventional filler lime, after acquired best bitumen content material of the combination has additionally expanded balance and sturdiness whilst compared with 60/70 grade of bitumen.& agricultural wastes ought to be efficiently in construction to deal with environmental & economic difficulty. So presently different kind of mineral fillers like RHA, Fly ash, glass powder, marble dust and so on are utilized in location of conventional mineral filler.
So the usage of upward thrust husk ash in warm mix asphaltic pavement is lagging behind in both research & application fields that is quite observable in maximum growing countries like India. This is the number one motivation underlying choice of this hot mix asphalt through the usage of RHA as a mineral filler as the present studies location
This have a look at may have superb impact on the environment because it will reduce the volume of waste agricultural product to be disposed off by way of incineration and land filling. It will now not simplest upload price to agricultural waste however will broaden a technology that is eco pleasant.

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