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A Beeline For Making Flexible Pavements By Means Of Discarded Plastic And Ferriginious Quartz Stone Powder

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ABSTRACT

Every day, the discard waste plastics and types of mineral filler like cement, quartz powder, stone dust, marble waste etc., are dumped in the earth surface. It may cause environmental pollution. Nowadays, many engineers and industrialist are investigating the possibilities of waste plastics and mineral waste in flexible pavement. An attempt has been made to use the plastic as aggregate coating in order to increase road performance and durability. Plastic wastes like low density polythene, polypropylene, polythene, Terephthalate are used. These waste plastics are cut into small pieces. Aggregate are heated to a certain temperature and the spread over the heated aggregate. Due to heating this plastic gets softened and forms a coating as layer over these aggregate. The result indicates that the 10% of plastic coated aggregate doesn't disqualify the material and no negative influence on the quality asphalt mixture. The durability of the asphalt pavement is related to the appropriate proposing of mineral materials.

Keywords: Beeline, Ferriginious

INTRODUCTION

In general, there are two types of roads; Rigid Pavements roads and Flexible Pavement Roads. For Rigid Roads material used is concrete and for Flexible Roads bitumen is used. In India, mostly the Flexible Pavement Roads are available. For economical road construction new techniques, new materials are used. The usage of plastic in India increased day by day. Plastics bags used for packaging materials are made up of polymer such as; PE, polypropylene (PP) and polystyrene (PS).

These materials are used based on their characteristics such as thickness, solubility and softening temperature. The materials can be shredded into smaller sizes and mixed with asphalt for road construction. It is also used for overthrowing off waste. The used plastic once unnerved to the Environment it would not get putrefied, it is a non-biodegradable material. It causes most of the pollution and hazards in the environment. The waste plastic used as landfill or they incinerated, both the processes are hazards to environment. These cause land and air pollution. Even they cannot be re-used for same purpose.

As a whole plastic is not an eco-friendly material. In this research paper, an approach is made to use the waste plastic and Prosopis juliflora and quartz powder in road as properties enlightening materials for construction of flexible pavement. Its granule thickness/sieve size is 150 microns – 4.75mm and it adheres to IS code – 383: 1970. Specific gravity for Prosopis juliflora and Ferrugineous quartz stone powder is 2.61.The combination of these wastes with aggregates and bitumen revealed great results. As the LDPE (Low- density polyethylene) can be used as the blending material to develop quality of roads. The flexible pavement Agonizes may fails during monsoon and under high impact loading due to the brakes of moving vehicles. The introduction of waste plastic and Prosopis juliflora and Ferrugineous quartz stone powder in road blended pavement shown great results against such failures. Therefore, use of waste plastic and Prosopis juliflora and Ferrugineous quartz powder in road construction could be a great achievement to save our environment against hazards of these non-bio-degradable materials. Also helps to advance the flexible pavements properties. Bitumen, on other hand, is a thick black and sticky oil based substance. It is considered as a residue or byproduct from the fractional distillation of crude oil.

Bitumen also contains about 3000 to 2000 chemical components, with an average of 500 to 700 of these being chemical components. Bitumen is also one of the heaviest

fractions of crude oil with the highest boiling point temperature of 525ºc. There are three types of bitumen: cutback bitumen, bitumen primers, and modified bitumen. Various grades or types of bitumen used for flexible pavements purposes include grade: 30 to 40, 40 to 60, and 80 to 100. With the new innovation on how to reuse the waste plastics for road construction, it would be of great effect if it is carried out Nigerian roads with the result leading to an effective management of the solid waste.

Scope Of The Study

The aim of this investigation is to experimentally investigate the stability of Waste Plastic as a substitute materials for aggregate and Prosopis juliflora and Ferrugineous quartz stone powder as a filler material for Bitumen in Flexible Pavement aimed to study the stability of the flexible pavements. The experimental parameters were the percentage of the plastic substitution. The Specimens will be prepared with 10% of Plastic Coated Aggregate and 0%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45% of Prosopis juliflora and Ferrugineous quartz stone powder waste is substituted in bituminous mix. The effects of Plastics and Prosopis juliflora and Ferrugineous quartz stone powder on the flexible pavements will be evaluated through Marshall Stability Testing.

It produces increased Stability Value.

To produce the better performance and Stability nature.

Improve in the properties of the Bituminous mix provides the solution for disposal in a useful way.

Due to the better binding, it is good for heavy traffic areas and surface area for prolonged period of exposure to varied climatic conditions.

Modification made by using waste plastics as coating over aggregate and Prosopis juliflora and Ferrugineous quartz stone powder as a filler material in bituminous mix has effectively solving the disposal of the Plastics and Industrial Waste Products.

Provision of Flexible Pavements in lesser cost and to reduce the Waste to be generated. Maintenance cost of the road is almost nil. Better resistance to water and water stagnation.

Objective of study

Basic intention is to efficiently utilize the waste plastic in constructive way so that it can be beneficial to society however main objectives of current project work are:

To coat the aggregates with the waste plastic materials, To check the properties of bituminous mix specimen, due to coating of waste plastic materials, To compare the properties of bituminous mix specimen with the properties of coated aggregates

METHODOLOGY

MATERIALS

Aggregate ○ Natural coarse Aggregate ○ Plastic coated aggregate, Bitumen, Prosopis juliflora and Ferrugineous quartz stone powder.

Aggregate

Aggregates are simply any collection of rocks. In the aggregates industry, these rocks are classified as crushed stone, sand, gravel and slag.

Natural Course Aggregate

Coarse aggregate is one of the most important materials used for flexible pavement construction. The coarse aggregate should be screened crushed rock, angular in shape, free from dust particles, clay, vegetations and organic matters. Natural coarse aggregate is shown in fig 1. Aggregate forming the main skeleton of pavement should be tested against their suitability as a pavement construction with reference to the MORTH.

Fig 1: Natural Coarse Aggregate

Physical Properties

S.NO	PROPERTIES	RESULT	PERMISSIBLE VALUE AS PER MORTH
1	Impact value	10.135	24% Max
2	Los angles	20.05	30% Max
3	Water absorption	1.25	2% Max
4	Specific gravity	2.985	2 – 3
5	Crushing strength	23.52	30% Max

Plastic Coated Aggregate

Plastics are usually synthetic, most commonly derived from petrochemicals but many are partially natural. Plastics are classified in two types‟ thermoplastics and thermosetting polymers. Thermoplastics are plastics that do not undergo chemical changes in their composition when heated and can be moulded again. Here the plastic used is PVC (Polyvinylchloride) is the most important plastic produced today. For few years ago, throw away products made of PVC havebeen a leading too cause of dioxin pollution in incinerators and when burned. Since it is a thermoplastic polymer, is widely used in construction because it is cheap, durable and easily worked. The PVC wastes are collected from domestic wastes, mineral water bottles, credit cards, toys, pipes and gutters, furniture, pens etc.,

Fig 2: Plastic Coated Aggregate

Physical Properties Of 10% Pca

S.NO	PROPERTIES	RESULT	PERMISSIBLE VALUE AS PER MORTH
1	Impact value	7.105	24% Max
2	Los angles	17.02	30% Max
3	Water absorption	1	2% Max
4	Specific gravity	2.75	2 – 3
5	Crushing strength	21.25	30% Max

Test On Aggregate

Impact test
Los Angeles abrasion test
Crushing test
Specific gravity test
Water Absorption test

Impact Test

The impact machine shall rest without wedging or packing up on the level plate, block or floor, so that it is rigid and the hammer guide columns are vertical.
The Cup shall be fixed firmly on the position on the base of the machine and the whole of the test sample placed in it and compacted by a single tamping of 25 strokes of the tamping rod.
The hammer shall be raised until its lower face is 380 mm above the upper face of the aggregate in the cup, and allowed to fall freely on to the aggregate. The test sample shall be subjected to a total of 15 such blows each being delivered at an interval of not less than one second.
The crushed aggregate shall then be removed from the cup and the whole of it sieved on the 2.36 mm IS sieve until no further significant amount passes
in one minute. The fraction passing the sieve shall be weighted to an accuracy of 0.1 g.
The fraction retained on the sieve shall also be weighted and, if the total weight is less than the initial weight by more than one gram, the result shall be discarded and a fresh test made.
The fraction retained on the sieve shall also be weighted and, if the total weight is less than the initial weight by more than one gram, the result shall be discarded and a fresh test made.
The above procedure followed for the different percentage of plastic coated coarse aggregate test.

Fig 3: Impact Test Los Angeles Abrasion Test

The test sample and the abrasive charge shall be placed in the Los Angeles abrasion testing machine and the machine rotated at a speed of 20 to 33 rev/min.
For grading‟s A, B, C and D, the machine shall be rotated for 500 revolutions; for grading‟s E, F and G, it shall be rotated for 1000 revolutions.
The machine shall be so driven and so counter-balanced as to maintain a substantially uniform peripheral speed.
If an angle is used as the shelf, the machine shall be rotated in such a direction that the charge is caught on the outside surface of the angle.

At the completion of the test, the material shall be discharged from the machine and a preliminary separation of the sample made on a sieve coarser than the 1.70 mm IS Sieve.
The finer portion shall then be sieved on a 1.70 mm IS Sieve shall be washed and dried in an oven at 105 to 110˚ C to a substantially constant weight, and accurately weighted to the nearest gram.
The above procedure followed for the different percentage of Plastic Coated Aggregate.

Fig 4: Los Angeles Abrasion Test Crushing Strength Test

The cylinder of the test apparatus shall be put in position on the base plate and the test sample added in thirds, each third being subjected to 25 strokes from the tamping rod. The surface of the aggregate shall be carefully leveled and the plunger inserted so that it rests horizontally on this surface, care being taken to ensure that the plunger does not jam in the cylinder.

The apparatus with the test sample and plunger in position, shall then be placed between plates of testing machine and loaded at uniform rate as possible so total load is reached in 10 minutes. The total load shall be 40 tones.
The load shall be released and the whole of the material removed from the cylinder and sieved on 2.36 mm IS Sieve.
The above procedure to be followed for the different percentage of plastic coated aggregate.

Fig 5: Crushing Test Specific Gravity Test

The clean, dried weight of the empty pycnometer is taken as W1 gram is to be found.
The amount of dry aggregate is filled in the pycnometer. Then it is weighted. Let this be W2gm
The remaining space in the specific gravity bottle is filled with the water, so that all void space inside the aggregate is filled with water and then takes a weight. Let this be W3gm
Then it is emptied, cleaned and dried. It is filled with fresh distilled water and then kept in water bath for at least half an hour at temperature 27±0.1˚ C
The bottle is then removed and cleaned from outside. The specific gravity bottle containing distilled water is now weighted. Let this be W4 grams
The above procedure followed for the different Percentage of plastic coated aggregates.

Fig 6: Specific Gravity

Water Absorption Test

The cylinder of the test apparatus shall be put in position on the base plate and the test sample added in thirds, each third being subjected to 25 strokes from the tamping rod.
The surface of the aggregate shall be carefully levelled and the plunger inserted so that it rests horizontally on this surface, care being taken to ensure that the plunger does not jam in the cylinder.
The apparatus with the test sample and plunger in position, shall then be placed between the plates of the testing machine and loaded at as uniform a rate as possible so that the total load is reached in 10 minutes. The total load shall be 40 tones.
The load shall be released and the whole of the material removed from the cylinder and sieved on 2.36 mm IS Sieve for thestandard test, or the appropriate sieve given in the fraction passing the sieve shall be weighted.
The above procedure to be followed for the different percentage of plastic coated aggregate.

Fig 7: Water Absorption Test

Bitumen

Bitumen is a sticky, black and highly viscous liquid or semi-solid, in some natural deposits. It is also the residue or by product of fractional distillation of crude petroleum. Bitumen composed primarily of highly condensed polycyclic aromatic hydrocarbons, containing 95% carbon and hydrogen (± 87% Carbon and ±8% hydrogen), up to 5% sulphur, 1% nitrogen, 1% oxygen and 2000 ppm metals. Also bitumen is mixture of about 300-2000 chemical components, with an average of around 500-700.It is the heaviest fraction of crude oil, the one with highest boiling point (525^0C). One can identify the bitumen in Fig 3.3

Fig 8: Bitumen

Different Forms Of Bitumen

Cutback Bitumen: A suitable solvent is mixed to reduce viscosity.
Bitumen Emulsion: Bitumen is suspended in finely divided condition in aqueous medium 60% bitumen and 40% water.
Bituminous Primers: Mixing of penetration bitumen with petroleum distillate.
Modified Bitumen: Blend of bitumen with waste plastics & or Crumb rubber.

Various Grades Of Bitumen

VG10- Use in high stressed areas like intersections, toll plazas, truck terminals, truck lay-byes in lieu of 30/40 grade.
VG20- Paving applications for most part of India on lieu of 60/70 grade of bitumen.
VG30- Paving application in cold climatic conditions of North India and in high altitude regions.
VG40- Spraying applications, paving applications in cold regions in lieu of 80/100 grade.

The Desirable Property Of Bitumen

Good Cohesive and adhesive binding property.
Water repellent Property.
It is its thermoplastic nature, (Stiff when cold liquid when hot), that makes bitumen so useful.

Test On Bitumen

Ductility test
Softening point test
Viscosity test
Penetration test

Ductility Test

Melt the bituminous test material completely at a temperature of 75°C to 100°C above the approximate softening point until it becomes thoroughly fluid.
Strain the fluid through IS sieve 30.
After stirring the fluid, pour it in the mould assembly and place it on a brass plate.
In order to prevent the material under test from sticking, coat the surface of the plate and interior surface of the sides of the mould with mercury or by a mixture of equal parts of glycerine and dextrin.
After about 30-40 minutes, keep the plate assembly along with the sample in a water bath. Maintain the temperature of the water bath at 27°C for half an hour.
Remove the sample and mould assembly from the water bath and trim the specimen by levelling the surface using a hot knife.
Replace the mould assembly in water bath maintained at 27°C for 80 to 90 minutes.
Remove the sides of the moulds.

Hook the clips carefully on the machine without causing any initial strain.
Adjust the pointer to read zero. Start the machine and pull two clips horizontally at a speed of 50 mm per minute

Note the distance at which the bitumen thread of specimen breaks.
Record the observations in the perform and compute the ductility value report the mean of two observations, rounded to nearest whole numbers as the "Ductility Value".

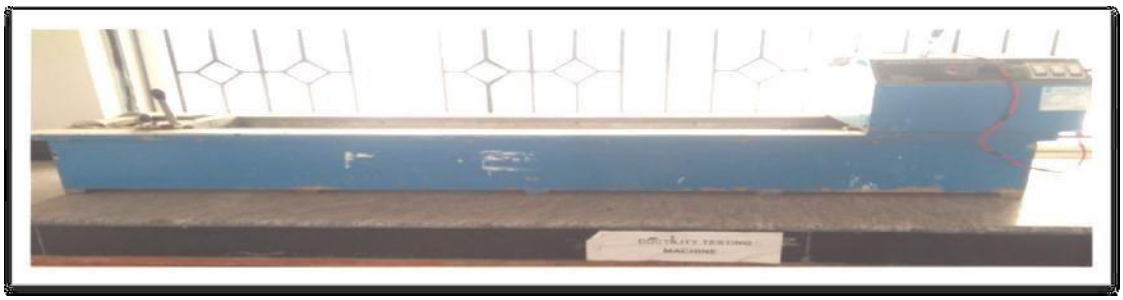

Fig 9: Ductility Test Softening Point Test

Heat the material to a temperature between 75°C-100°C above its softening point, stir until, it is completely fluid and free from air bubbles and water. If necessary filter it through IS Sieve 30.
Place the rings, previously heated to a temperature approximately to that of the molten material. On a metal plate which has been coated with a mixture of equal parts of glycerin and dextrin.
After cooling for 30 minutes in air, level the material in the ring by removing the excess with a warmed, sharp knife.

Assemble the apparatus with the rings, thermometer and ball guides in position.
Fill the bath with distilled water to a height of 50mm above the upper surface of the rings.
The starting temperature should be 5 0 C. Apply heat to the bath and stir the liquid so that the temperature rises at a uniform rate of 5±0.50C per minute 5.
Note down the temperature when any of the steel ball with bituminous coating touches the bottom plate.

Fig 10: Softening Point Viscosity Test

The tar cup is properly leveled and water in the bath is heated to the temperature specified for the test and is maintained throughout the test. Stirring is continued.
The sample a material is heated at the temperature 20C above the specified test temperature and the materials is allowed to cool.
During this material is continuously stirred. When materials reaches slightly above test temperature the same is poured in the cup, until the levelling peg on the value rod is just immersed.
In the graduated receiver (cylinder) 20 ml of mineral oil or one percent by weight solution of soft soap is poured.

During this the mineral is continuously stirred. When material reaches slightly above test temperature the same is poured in the tar cup, until the levelling peg on the value rod is just immersed.
In the graduated receiver (cylinder) 20 ml of mineral oil or one percent by weight solution of soft soap is poured.
This receiver is placed under the orifice. When the sample material reaches the specified test temperature within 0.10C and is maintained for 5 minutes, the valve is opened.
The stop watch is started, when cylinder record 25 ml. The time is recorded for flow up to a mark of 75ml i.e., 50 ml of the test sample to flow through the orifice.

Fig 11: Viscosity Test Penetration Test

Soften the material to a pouring consistency at a temperature not more than 600C for tars and 900C for bitumen above the approximate softening point and stir it thoroughly until it is homogenous and is free from air bubbles and water.
Pour the melt into the container to a depth at least 10mm in excess of the expected penetration. Protect the sample from dust and allow it to cool in a temperature between 150C to 300C for one hour. Then place it along with the transfer dish in the water bath at 250±0.10C and allow it to remain for 1 to 1 ½ hour. The test is carried out at 250±0.10C, unless otherwise stated.
Fill the transfer dish water from the water bath to depth sufficient to cover the container completely. Place the sample in it and put it upon the stand of the penetration apparatus.
Clean the needle with benzene, dry it and load with weight. The total moving load required is 100±0.25gms, including the weight of the needle, carries and super-imposed weights.
Adjust the needle to make contact with the surface of the sample. This may be done by placing the needle point with its image reflected by the surface of the bituminous materials
Make the pointer of the dial to read zero or note the initial dial reading
Release the needle for exactly five seconds
Adjust the penetration machine to measure the distance penetrated
Make at least 3 reading at points on the surface not less than 10mm apart and not less 10mm from the side of the dish. After each test return the sample and transfer dish to the water bath and wash the needle clean with benzene and dry it.
In case of material of penetration greater than 225 three determinations on each of the two identical tests specimens using a separate needle for each determination should be made, leaving the needle in the sample completion of each determinations to avoid disturbance of the specific sample.
The results of the bitumen will be compared with VG40 Grade as Standard Value as per the Codal Specifications.

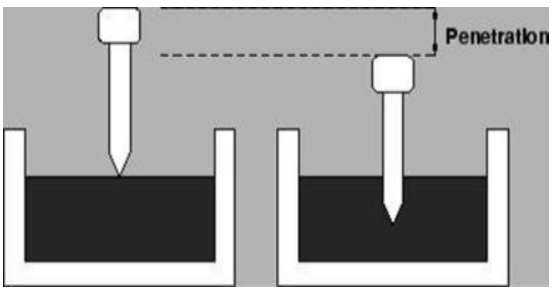

Fig 12: Penetration Test 3.4 Prosopis Juliflora and Ferrugineous Quartz Stone Powder–Filler Material

Prosopis juliflora and Ferrugineous quartz stone powder is mainly used for concreting purposes. Its granule thickness/sieve size is 150 microns – 4.75mm and it adheres to IS code – 383: 1970. Specific gravity for Prosopis juliflora and Ferrugineous quartz stone powder is 2.61.
A large amount of Prosopis juliflora and Ferrugineous quartz stone powder waste is dispose into landfills every year.
This waste was obtained as a byproduct during the production of aggregates through the crushing process of rocks in rubble crusher units.
The increasing value of waste will have significant impact towards health and environment.
Recycling such wastes by incorporating them into building materials is a practical solution for pollution problem.
Therefore, this research was to examine the possibility of Prosopis juliflora and Ferrugineous quartz stone powder to be incorporated in fired clay bricks.
In this research, the composition and Concentration of heavy metals was determined by using X-Ray Fluorescence Spectrometer (XRF).

The research also consists of physical and mechanical properties of the fired clay bricks by utilizing Prosopis juliflora and Ferrugineous quartz stone powder waste.
Furthermore, the density and shrinkage were also in standard range.

All physical and mechanical results were complied with the BS 3921:1985 standard.
These materials could be an alternative low cost material for brick and at the same time provide a new disposal method for the waste.

Fig 13: Quartz Stone Powder& Prosopis Juliflora Ash 3.5 Making Of Specimen

We prepare the specimen by Dry Process. First, we take the required amount of Plastics, and then it has to be cleaned, dried and shredded it into 2.36-4.75 mm size. Aggregate is taken and it is heated to the nearly 160^0C and spread the shredded softened and forms as a layer over the aggregate. Now the Bitumen is heated and stirred carefully in order to get the well uniform mix. Prosopis juliflora and Ferrugineous quartz stone powder powder as a filler material in bituminous Sample mix. Specimen is prepared according to the mix proportions. Normally about 1200 grams of the mix would be required. After a homogenous mix is obtained 1200 grams of the mix is weighted and the same is placed in a preheated compaction mould. The mix is compacted by giving 50 blows of the hammer on the top. Then the hammer is reverse and 50 blows are again imparted. The freshly compacted specimens have cooled to a room temperature. The bulk density is determined by weighting the specimen first in air and then in water. The specimens are immersed in hot water at a testing temperature of 60 ^{0}C$\pm1^0$C for 30 to 40 minutes for the design of tar concrete mixture, this temperature is 38^0C$\pm1^0$C. The specimen is removed from the water bath and is placed with its axis horizontal in to the test heads. The complete assembly is quickly placed on base of the compression machine. The elapsed time after the removal of the test specimen, the water bath to the maximum load determination should not generally exceed 30 seconds. One can refer from Fig 3.14, 3.15&3.16.

Fig 14: Bituminous Mix Sample

Fig 15: Mould Preparation

Fig 16: Prepared Specimens

Marshall stability

Maximum load required to produce failure in specimen. When preheated and load applied at constant strain (5cm/min). Deformation at failure point expressed in the units of 0.25 is called flow value. The fig 3.8 shows apparatus of Marshall Stability Test.

All sized fraction of aggregate in separate pans are either placed in hot oven or placed in hot plate, to the mixing temperature the quantity of aggregate is taken so as to produce a batch which will result in a compacted specimen of 63.5mm height bitumen binder of specified grade is also greater to the required mixing temperature.

Then heating is done for more than one hour.

The different size of coarse aggregates is put together in a desired position and predetermined quantity of bitumen is poured in.

The mixing operation is carried out either manually or by using an electrically operated mixer.

Normally about 1200 grams of the mix would be required. After a homogenous mix is obtained 1200 grams of the mix is weighted and the same is placed in a preheated compaction mould. At the start of the compaction, the mix should attain the desired compacted temperature.

Before preparing the batch the face of compaction hammer and compaction mould at least 3 in number are thoroughly cleaned and heated.

The compaction mould along with batch mix is placed on the compaction pedestal. The hammer face is placed over batch mix top.

The mix is compacted by giving 50 blows of the hammer on the top. Then the hammer is reverse and 50 blows are again imparted. If the tire pressure on the pavement is 7Kg/cm2, the mix is usually compacted with 50 blows on either side. Asphalt institute recommends , 75 blow on either side for a tire pressure of 17 kg/cm2

Determination of bulk density: The bulk density is performed as soon as the freshly compacted specimens have cooled to a room temperature. The bulk density is determined by weighting the specimen first in air and then in water.

Fig 17: Marshall Stability

Detailed methodology

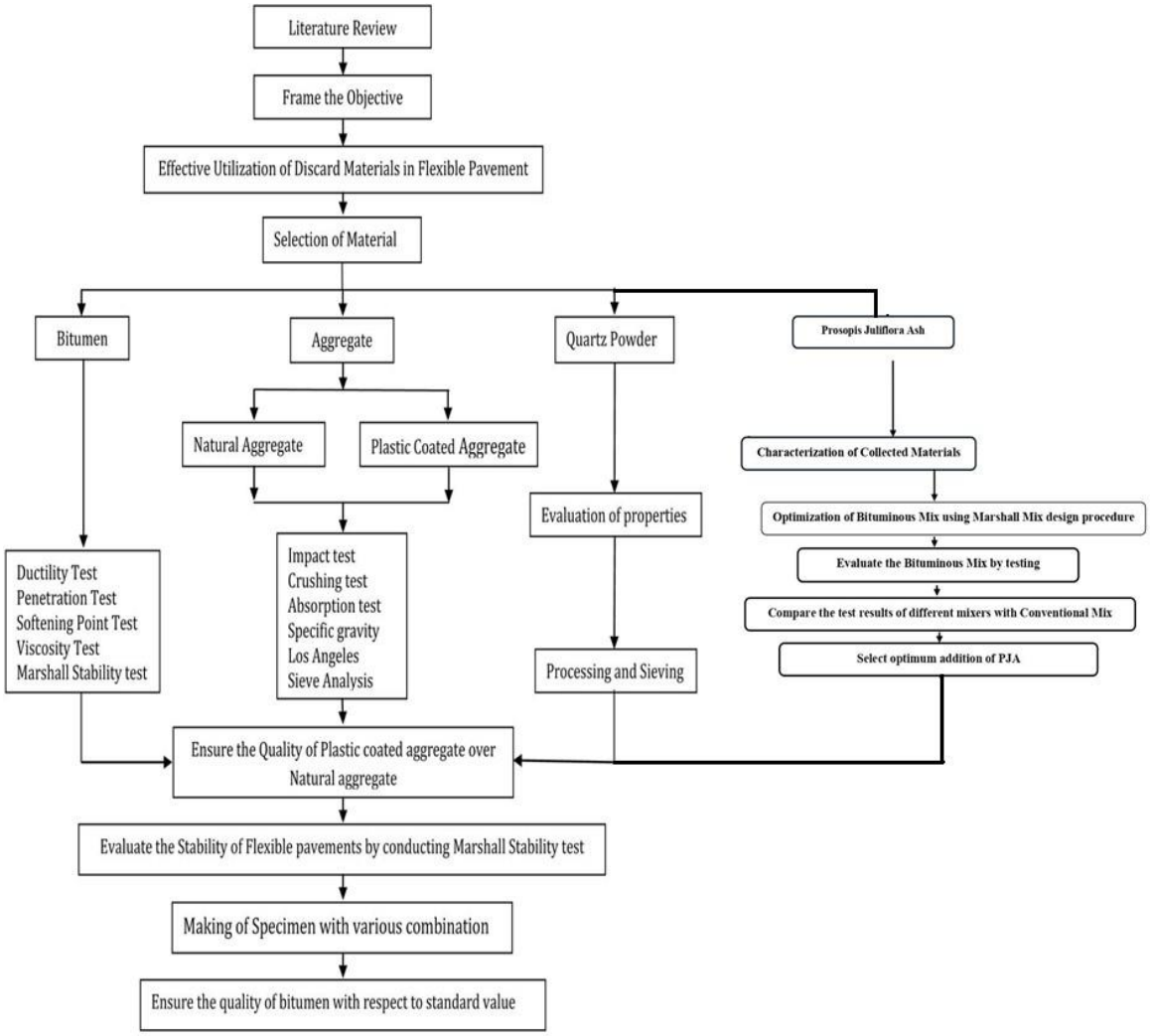

Fig 18: Flow Chart

RESULT AND DISCUSSION

Tests On Aggregate

Impact test
Los Angeles abrasion test
Crushing test
Specific gravity test
Water Absorption test

Aggregate Impact Testing

The aggregate impact value is a measurement that offers resistance to sudden impact or shock, which may differ from its resistance to gradually applied compressive load.

Weight of surface dry sample (W_2gm) = 39gm

Weight of Fraction passing the 2.36 mm Sieve (W_1gm) = 360gm

Impact strength of aggregate $= \frac{W2}{W1} \times 100$

= 10.135%

Los Angeles Abrasion Test

The percentage wear of the aggregate due to rubbing with steel balls is determined and is known as Los Angeles Abrasion Value.

Original weight of aggregate sample (W_1gm) = 5000gm

Weight of sample Retained on 1.7mm IS sieve (W_2gm) = 3997.5gm

Loss in Weight (W_3gm) = 1002.5gm

Abrasion value $= \frac{W3}{W1} \times 100$

= 20.05%

Water Absorption Of Aggregate

Moisture content of an aggregate is defined as the weight of surface moisture (i.e., the moisture in excess of that held by aggregate in a saturated surface dry condition), expressed as a percentage of the weight of the aggregate in saturated surface dry condition.

Weight of dry sample (W1gm) = 200gm

Weight of saturated specimen (W2gm) = 203.25gm

Water absorption $= \frac{W2-W1}{W1} \times 100$

= 1.25%

Aggregate Specific Gravity

The specific gravity of an aggregate is considered to a measure of the quality or strength of materials. Stones having low specific gravity values are generally weaker than those having higher value.

Weight of empty pycnometer (W1gm) = 662gm
Weight of pycnometer with fine aggregate (W2gm) = 1662gm
Weight of pycnometer + sand + water (W3gm) = 2088gm
Weight of pycnometer + water (W4gm) = 1423gm

Specific gravity $= \frac{W2-W1}{(W2-W1)-(W3-W4)} \times 100$

= 2.985

Aggregate Crushing Value

The „Aggregate crushing Value" gives a relative measure of the resistance of an aggregate to crushing under a gradually applied compressive load.

Weight of surface dry sample (W1gm) = 2960gm
Weight of Fraction passing the 2.36 mm Sieve (W2gm) = 705.68gm

Impact strength of aggregate $= \frac{W2}{W1} \times 100$

= 23.52%

Aggregate test result

Table 1: Comparative result for NCA and PCA

S. No.	Properties	Natural Coarse Aggregate	10% Plastic Coarse Aggregate	Permissible Value As Per Morth
1	Impact value	10.135	7.105	24% Max
2	Los angles	20.05	17.02	30% Max
3	Water absorption	1.25	1	2% Max
4	Specific gravity	2.985	2.75	2 – 3
5	Crushing strength	23.52	21.25	30% Max

Test On Bitumen

Ductility test
Softening point test
Viscosity test
Penetration test

Ductility Test

The Ductility Test gives a measure of adhesive property of Bitumen and its ability to stretch.
Ductility serves as satisfactory binder in improving the physical interlocking of the aggregate.

Liquid used in Bath = water
Grade of bitumen = VG40
Ductility of bitumen sample = 26.5 cm

Table 2: Ductility value required for paving bitumen as per BIS

Property	VG10	VG20	VG30	VG40
Ductility at 25°C,cm minimum after thin film oven test	75	50	40	25

Softening Point Test

Softening point of bitumen is the temperature at which temperature at which substance attains particular degree of softening.

Grade of Bitumen : VG40
Liquid used in Bath : Water

Table 3: Softening Point temperature reading

Test Property	Ball No.1	Ball No.2	Mean Value of softening Point
Temperature at which sample touches bottom plate	47.3	48.5	47.9°C

Viscosity Test

Property that retards its flow due to internal friction and it is a measure of resistance to flow of the liquid

Table 4: Viscosity grading of bitumen and consistency properties

S. No	Viscosity Grading	Absolute Viscosity at 60°C,poise (min)	Kinematic Viscosity at 135°C cost/s(min)	Range of penetration value at 25°C
1	VG10	800	250	80-100
2	VG20	1600	300	60-80
3	VG30	2400	350	50-70
4	VG40	3200	400	40-60

Material = Hot bitumen
Grade = VG40
Specified test temperature, °C = 25°C
Size of orifice, mm = 10 mm
Actual test temperature, °C = 60°C
Viscosity = 28 Seconds

Penetration Test

The penetration test determines hardness of materials by measuring depth in tenth of a millimeter to which a standard needle will penetrate vertically under specified conditions of standard load and temperature.

Table 5: Penetration dials reading

S.no	Penetrometer dial reading			Standard deviation
	Initial	Final	penetration	
1	0			
2	0			
3	0			
4	0			
5	0			
6	0			
7	0			
8	0			
9	0			
10	0			

Repeatability = (No. of value between X + σ)/n x 100
X+σ = 37.385
X-σ = 36.015
Repeatability = 30%

Marshall Stability number and flow value

Maximum load required producing failures in specimen when preheated and load applied at constant strain (5cm/min). Deformations at failure point expressed in the units of 0.25 mm are called flow value.

Mix proportion

5% of bitumen = 3.5/100 x 1200 = 4.2 grams

Table 6: Marshall Stability Value on Bituminous Mix

S. No	Bitumen %	FQP (%)	PJA (%)	Plastic	Aggre gate (g)	Dia (mm)	Height (mm)	Stability (kg)
1	3.5%	0%	0%	0%(0 g)	1140	100	64	219.50
2	3.5%	5%	5%	10% (6 g)	1134	100	64	230.54
3	3.5%	10%	10%	10% (6 g)	1134	100	64	255.85
4	3.5%	15%	15%	10% (6 g)	1134	100	64	271.45
5	3.5%	20%	20%	10% (6 g)	1134	100	64	291.67
6	3.5%	25%	25%	10% (6 g)	1134	100	64	307.11
7	3.5%	30%	30%	10% (6 g)	1134	100	64	320.18
8	3.5%	35%	35%	10% (6 g)	1134	100	64	407.10
9	3.5%	40%	40%	10% (6 g)	1134	100	64	324.55
10	3.5%	45%	45%	10%(6 g)	1134	100	64	204.35
11	3.5%	50%	50%	10%(6 g)	1134	100	64	202.15

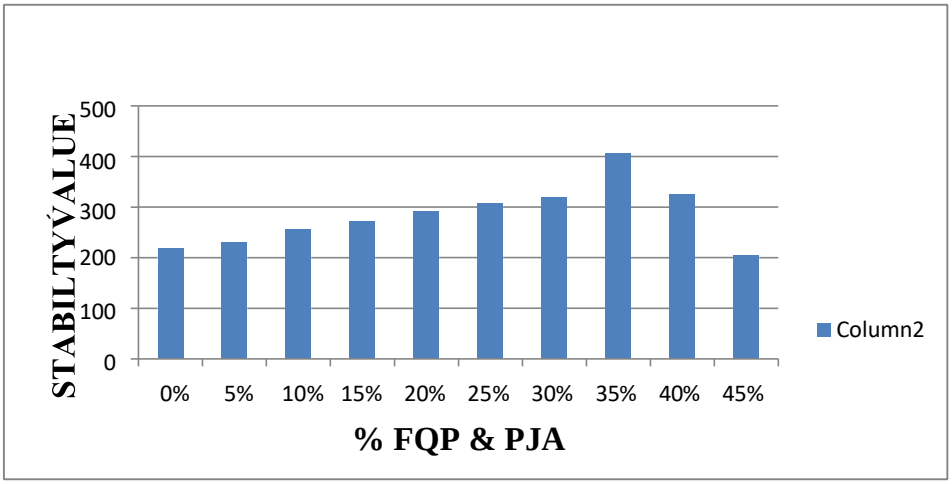

Fig 19: Marshall Stability graph

CONCLUSION

The present study on the topic "Experimental investigations of making flexible pavement by means of discarded plastic as well as mineral fillers" has been carried out to assess the effect of waste plastic & Stone dust in mix design. The properties of plain aggregate were compared with that of waste plastic coated aggregates and properties of bitumen were compared with that of plastic and Stone dust blended bitumen. The main conclusions from the study were

Impact Value of the natural coarse aggregate is 10.135% and it is reduced to 7.105% for 10% Plastic coated aggregate.

Los Angeles Abrasion Value of the natural coarse aggregate is 20.05% and it is reduced to17.02% for 10% Plastic coated aggregate.

Water Absorption Value of the natural coarse aggregate is 1.25% and it is reduced to 1% for 10% Plastic coated aggregate.

Specific Gravity of the natural coarse aggregate is 2.985 and it is reduced to 2.75 for 10% Plastic coated aggregate.

Crushing Value of the natural coarse aggregate is 23.52%. The value is reduced to 21.25 % for 10% Plastic coated aggregate.

Bitumen value of penetration test is 36.7 and the repeatability of bitumen should be 30% for number of values.

Bitumen value of viscosity test is 28 seconds due to measure of resistance to flow of the liquid

Bitumen mean value of softening point test is 47.9°Cwhich substance attains particular degree of softening.

The ability of stretch Bitumen value of ductility test is 26.5 cm

On the observation of Marshall Stability Value for the Control Specimen is 219.5 kg. The Value increases for 10% of PCA and addition of 0%, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45% of Prosopis juliflora and Ferrugineous quartz stone powder in bitumen.

The results of Plastic Coated Aggregate and Prosopis juliflora and Ferrugineous quartz stone powder incorporated pavements are better when compared to conventional one.

In short, we can conclude that, using 10% of Plastic Coated aggregate and Bitumen with addition of Prosopis juliflora and Ferrugineous quartz stone powder is more favorable for the Flexible Pavement Construction.

From the detailed study, it can be concluded that the deploy of plastics and Prosopis juliflora and Ferrugineous quartz stone powder proved as effective one for the construction flexible pavements. No doubt, this kind of new beeline in modern era is not only beneficial to the construction industry but nature as well. However, this methodology may be adopted in field after further preformed study.

In general, one cannot ban the use of plastics and generation of Prosopis juliflora and Ferrugineous quartz stone powder in developing country like India. Therefore, these waste materials will be properly utilized and managed by suitable innovate methodology as discussed above. No doubt, it may be new path way for making and ensuring conductive environment.

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