Issue 3 volume 4 ISSN: 2321-8134

IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

RECYCLED TYRE RUBBER AND PLASTIC MODIFIED BITUMEN FOR ROAD ASPHALT MIXTURE

Sonali A. Wanjare[1], Neha A. Durge[2], Rutik R. Gambhirrao[3], Sheikh Shahbaz Hasan Anwarul Hasan [4]

[1]UG Student, Civil Department, J.D.I.E.T., Yavatmal, Maharashtra, India,wanjaresonali1998@gmail.com
[2]UG Student, Civil Department, J.D.I.E.T, Yavatmal, Maharashtra, India,durgeneha19@gmail.com
[3]UG Student, Civil Department, J.D.I.E.T, Yavatmal, Maharashtra, India,rutikgambhirrao53@gmail.com
[4]UG Student, Civil Department, J.D.I.E.T, Yavatmal, Maharashtra, India, shahbazhasan60459@gmail.com

Abstract

The consumption of waste materials like plastics and crumb rubber in flexible pavement construction is being increasingly stimulating so as to reduce environmental effect. Plastics and crumb rubbers are among of all waste material. In todays scenario the way in which human lives in metropolitian cities the use of solid waste is increasing and the reliance of population on plastic is boosting the plastic waste quantity in municipal solid waste. Similarly, synthetic Crumb rubber is used for manufacturing vehicles tires. Disposal of plastic and crumb rubber is very huge problem standing in front of most of municipalities. At the same time, demand for vehicles increased continuously so the necessity of road with better quality and engineering design. This waste plastic and crumb rubber can be used to party replace the material which is generally used such as bitumen to enhancing desired mechanical characteristics such as ductility, softening point, flash and fire point etc for particular road mix. In this paper, a comparison between waste crumb rubber and waste plastic in different proportions such as 8%,10%,12%,14%,20%,30% etc by weight of bitumen to analyse the better result.

Index Terms: waste crumb rubber, waste plastic, bitumen, Aggregate etc.

---------- *** ----------

1.INTRODUCTION

Road and highways are the simplest way of transportation which is easily accessible to the people. So the roads required maintenance to be in good condition. The degree of excellence of roads rely upon materials used for construction. Waste tire and plastic is non-biodegrable material hence it is used by recycling process. . Each respective tire manufactured is decided with specific purpose that it will go through recycling inspite of being re-treading process. There are two types of pavement viz, flexible and rigid pavement.In flexible pavement construction the material used for top surface is bitumen coating and on the top surface of rigid pavements have PCC or RCC which are stiffer than flexible pavements. The flexible pavements should be built in layers and ensuring that under application of load layers should not be overstressed. The maximum stress is occurs on the top surface and therefore the top surface is made up of high quality material like, bitumen. In this paper the aim is to get economical mix design with adequate proportion of waste material such as crumb rubber and waste plastic with bitumen to achieve the desired properties such as durability, softening point etc. In flexible pavements construction, bitumen used as binding material for the aggregate together by coating over the aggregate. Due to this the strength of road is improve. And its resistance towards water is increases.Various Grades of Bitumen used for pavement purpose:30/40, 60/70 and 80/100.In this paper grade of bitumen used is 60/70.

Objective of Project

1. Use of waste materials such as plastic and waste recyclable tires of vehicle, making it an effective ingredient for laying on flexible pavement
2. Use of modifiers increase the life of road by improving properties of road.
3. To identify the optimum proportion of waste plastic and crumb rubber to be added in the bitumen mix for getting the required strength
4. To compare the experimented results with the conventional pavement details and perform the economic analysis.

2. METHODOLOGY

TESTS FOR AGGREGATE

1. Sieve Analysis of Aggregates [IS: 2386 (part I) 1963]
2. Abrasion value of Aggregates [IS: 2386(part IV) 1963]
3. Aggregate Impact Value Test [IS 2386(part IV) 1963]
4. Aggregate CrushingValue Test [IS 2386(part IV) 1963]

TESTS FOR BITUMEN

1. Penetration Test [Is: 1203-1978]
2. Softening Point Test [Is: 1205-1978]

3. Ductility Test [IS: 1208-1978], Flash Point and Fire Point

TESTS FOR AGGREGATE

1. Sieve Analysis of Aggregates

The particle size distribution of the coarse and fine aggregates is determined through sieve analysis. The particles that passes through 4.75 mm sieve and retain on 0.075 mm sieve are fine aggregates and the particles that retain on 4.75 mm sieve are course aggregates.The standard test method for sieve analysis of fine and coarse aggregate is used for mainly determining thegrading, to determine particle size compliance of particle size distribution and also to provide data for quality control.The main devices required for this are balance machine, mechanical vibrating device. Sieve analysis is done by using sieve that are standardized by the IS code.For performing sieve analysis we need set of standard sieves with Lid at the top and pan at the base. A set of IS Sieves of sizes are 80mm, 63mm, 50mm, 40mm,31.5mm, 25mm, 20mm, 16mm, 12.5mm, 10mm, 6.3mm,4.75mm, 3.35mm, 2.36mm, 1.18mm, 600µm, 300µm, 150µm and 75µm. Series of sieves are arranged with progressively smaller openings in order of decreasing size to determine the particle size distribution of the test sample. Fineness modulus of aggregates is an index number which represents the mean size of the particles. In general a small value of index number indicates a fine aggregate while a large value of index number indicates a coarse aggregate. It is important to limit the quantity of test material on any given sieve so that every particle have the apportunity to reach the sieve openings while doing sieving operations.

Fig 3.12: IS Sieve and Sieve shaker.

2. Abrasion value of Aggregates

Abrasion testing measures the relative quality and sturdiness of mineral aggregates once subjected to abrasion and impact. There area unit 2 fashionable tests widely used today: la (L.A.) Abrasion take a look at and therefore the Micro-Deval take a look at.The values derived from either of those procedures can give you with specificinformation regarding the sturdiness of a sample combination. Samples area unit ready to mix specific plenty of particle size fractions, processed within the devices in line with the relevant take a look at ways, then washed overa fixed sieve to see proportion loss from abrasion.

Abrasion value Calculation:
Abrasion value =
$Totalweigh\ tofsampletaken/Weigh\ tretainedon$ one.$7mmseive$
× 100

Description of Procedure:

The aggregates sample consists of fresh aggregates dried in an kitchen appliance at 105° – 110°C. The aggregates sample ought to adapt to any of the Grading A, B, C, D or ETake specifically five weight unit of the sample for grades A, B, C & D, and 10 kg for grading E.Weight the sample, Place the fabric within the cylinder. Place abrasive charge within the cylinder. the full weight of steel ball ought to be 2500+10 g. Fix the duvet terribly tightly Rotate machine ten thousand revolution at a speed of 30-33 rate After revolution stop the machine and take away the mixture from it. Sieve this combination from IS Sieve one.7 mm. Wash dry and weight the material maintained on the sieve. Calculate abrasion worth.

Fig Weighting of aggregate for abrasion test

Fig.Deval Abrasion Testing Machine

Abrasion testing measures the relative quality and sturdiness of mineral aggregates once subjected to abrasion and impact. There area unit 2 fashionable tests widely used today: la (L.A.) Abrasion take a look at and therefore the Micro-Deval take a look at.The values derived from either of those procedures can give you with specificinformation regarding the sturdiness of a sample combination. Samples area unit ready to mix specific plenty of particle size fractions, processed within the devices in line with the relevant take a look at ways, then washed overa fixed sieve to see proportion loss from abrasion.
Abrasion value Calculation:
Abrasion value =
$Totalweigh\ tofsampletaken/Weigh\ tretainedon$
one.$7mmseive$
× 100

Description of Procedure:

The aggregates sample consists of fresh aggregates dried in an kitchen appliance at 105° – 110°C. The aggregates sample ought to adapt to any of the Grading A, B, C, D or ETake specifically five weight unit of the sample for grades A, B, C & D, and 10 kg for grading E.Weight the sample, Place the fabric within the cylinder. Place abrasive charge within the cylinder. the full weight of steel ball ought to be 2500+10 g. Fix the duvet terribly tightly Rotate machine ten thousand revolution at a speed of 30-33 rate After revolution stop the machine and take away the mixture from it. Sieve this combination from IS Sieve one.7 mm. Wash dry and weight the material maintained on the sieve. Calculate abrasion worth.

3. Aggregate Impact Value Test:

The 'aggregate impact value' offers a relative live of the resistance of associate aggregate to explosive shock or impact, that in some aggregates differs from Its resistance to a slow compressive load. The quantitative relation of the load of fines shaped to the full sample weight in every test shall he expressed as a percentage; the result being recorded to the primary decimal place:
Aggregate impact value = $W2/W1 \times 100$
Where,
B = Weight of fraction passing two.36-mm IS Sieve.
A = Weight of oven-dried sample.

Description of Procedure:

Sieve the fabric through twelve.5 millimeter and 10mm IS Sieve. Aggregate passed through twelve.5 millimeter and maintained on 10mm. Fill the mixture a lot of than 1/3rd depth of measure cylinder. offer twenty five mild blows with rounded finish of sound rod and add two a lot of layer within the same manner up to cylinder is full. take away the surplus material by straight knife. live Infobahn weight of aggregate (W1) in gramme. Place the cup firmly in position on the bottom of machine and place whole take a look at sample in it and compact by giving twenty five gentle stokes with tamping rod. Hammer lower face ought to be 380 millimeter on top of the surface of mixture and allow it to fall freely on the mixture sample. offer fifteen such blows at associate interval of not but one sec between successive falls. take away crushed mixture from the cup and sieve it through two.36mm sieve for one minute.Weight the fraction passing the sieve to associate accuracy of one gramme (W2). Also weight the fraction maintained within the sieve. The mean of 2 observations rounded to nearest integer and price is known as mixture impact price.

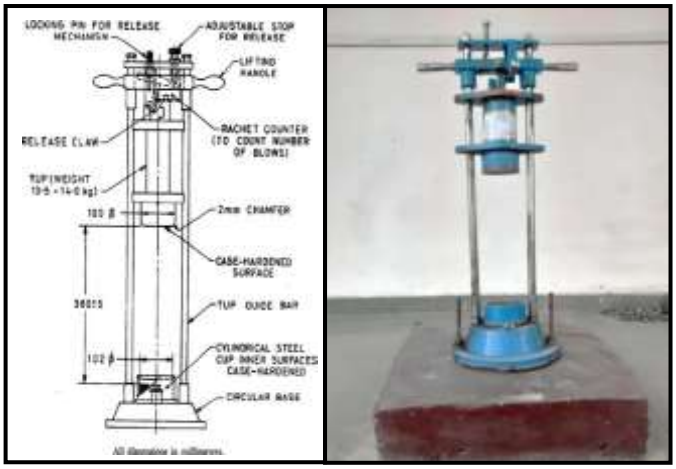

Fig. Aggregate Impact Test

4. Aggregate Crushing Value

Description of Procedure

Strain the material through 12.5 mm and 10 mm IS Sieve. The aggregate short through 12.5 mm sieve and collect on 10 mm sieve. Weight of material up to 3.25 kg. The depth of container fill upto 1/3 rd depth by aggregate. Give 25 gentle blows with rounded end of tapping rod and add 2 more layer in the same manner upto cylinder is full. Remove the excess material by straight knife. Empty the cylinder and weight the aggregate, up to 1gm.Fill this weighted quantity into the test mould in three layers as in the same manner as for the cylindrical measure. The total depth of the sample is about 10cm and surface a little below the top of the mould Level of the surface and place the plunger over it so that it rest horizontally on the surface of the aggregate Place this assembly on pedestal of compression testing machine Apply the load uniformly at a rate of 4tones per min (7.5KN/sec) until the total applied load is 40 tones (400KN)Then release the load take the aggregate out of cylinder and sieve them through 2.36mm IS Sieve weight this aggregate go through it to an a precision of 0.1 gm. Note down aggregate crushing value . The average of the two-reading approx.consider as the 'Aggregate Crushing Value'.

Fig Placing of aggregate in mould

Fig. Aggregate Crushing Test

TESTS FOR BITUMEN

1. Penetration Test [Is: 1203-1978]

hardness or consistency of bituminous material. Is calculated by penetration value test on bitumen. Bitumen penetration value lies between 80 & 100 indicates that its.An 80/100 grade bitumen. Penetration value is define as under the specific conditions of load time and temperature. the vertical distance negotiate or penetrated in bituminous material by the point of a standard needle. This distance is calculated in one tenths of a millimetre. Consistency of bitumen is assess with Penetration. It is not consider as appropriate for use in associated with the testing of road tar because of the high surface tension pointed out by these materials.

Description of Procedure:

Melt the bitumen and stir it up until the material is free fro lumbs and air voids at a temperature of 600^{o}C for tars and 900^{o}C for bitumen. Pour the material placed container to depth at least 10 mm more than the expecte penetration. And the material is placed into the container and it to cool in an atmosphere at a temperature between 15^{o}C to 30^{o}C for one hour. Then material placed into transfer dish and take a water bath For one hour. Then place The test is carried out at 25^{o}C±0.1^{o}C to cover the contaier completely Fill the transfer dish water from the water bath to depth enough,sample is placed in it and keep it over the stand of the penetration apparatus. with benzeneClean the needle, make free form moisture and load with the weight. The total moving load required is 100±0.25 gm., including carrier and super-imposed weights and the weight of the needle. surface of the sample and the needle should be in contact make proper adjustment to needle. This might be done by put down the point of needle in touch to its image reflected by the surface of the bituminous material. adjust the pointer of the dial to read zero or note down the initial dial reading. Release the needle for exactly five seconds. Calibrate the penetration machine and to count the distance penetrated. Take minimum 3 readings at points on the surface of the sample .least 10mm at distance not less than 10mm from the side of the dish. needle clean with benzene and dry it.

Fig.Penetration Test

2. Softening Point Test [Is: 1205-1978]

softening point of bitumen is the measure of its consisteny.Softening is a temperature at which bitumen will acquaire a particular degree of softening . It is measured at the temperature at which a steel ball passeses through a bitumen sample and falls through the height of 2.5cm when heated under water. The apparatus commonly use for determining the softening point is ring and ball apparatus. It consist of 2 steel ball, centering guides and the ring. It comprises of 3 metal plates. The top plate has a hole for insertion of thermometer. The middle plate has 2 slots for placing the ring and the bottom one is the flat. The distance between the top surface of bottom plate and the bottom surface of ring plate is 25mm. The cylindrical ring h as upper diameter of 17.5mm and height is 6.4mm. The centering guide ring has 3 pin such that they form imaginary circle to enable the movement of steel ball. The steel ball has diameter of 7.5mm and weight is 3.5gm. The softening point of bitumen helps us to know the temperature to which bitumen is heated for various road application. The IS code for softening point are IS: 334-1982, ASTM E28-67 or ASTM D36 or ASTM D6493

Description of Procedure:

Heat the bitumen to a temperature between 75 to 100℃ above its

softening point until it is completely fluid and free from air bubbles. Level the material in the ring by removing the excess with a warm sharp knife. Assemble the apparatus with the ring thermometer and ball guide in position Fill the bath with distilled water to height of 50mm above the upper surface of the ring the starting temperature should be 50 c Apply heat to the bath the stir liquid so that the temperature rise at a uniform rate 50c per minute. As the temperature increase the bituminous material soften and the ball sinks through the rings. The temperature when steel ball with bituminous coating touches the bottom plate. The average of the two readings to the nearest 0.50c is reported as the softening point.

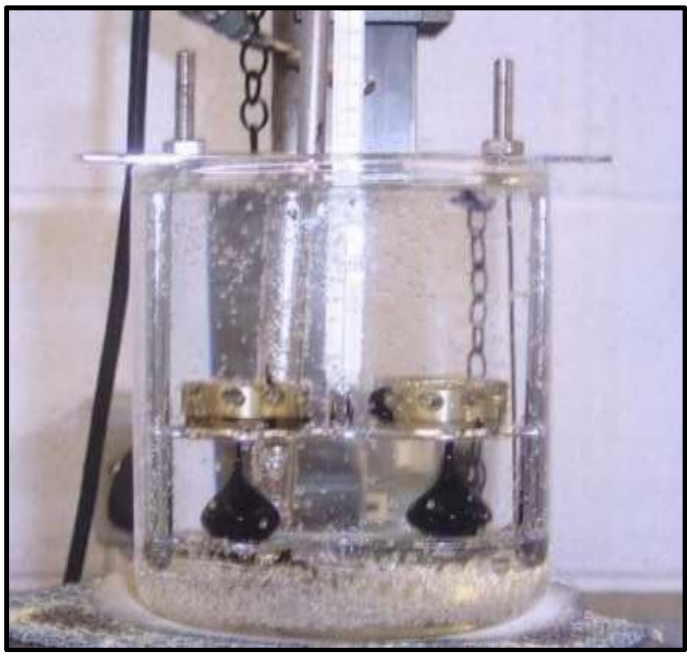

Fig. Ring and Ball Apparatus

3. Ductility Test [IS: 1208-1978]

The property of bitumen which allow it to undergo deformation or elongation is called Ductility of Bitumen. The ductility of bitumen is determined by measuring the elongation before breaking in centimeters (cm). The briquette specimen is pulled along the two ends apart at a specific speed and temperature. The Apparatus consist of Briquette Mould, Ductility machine with water bath and pulling device, Thermometer. In the flexible pavement construction it is desirable that the bitumen binder used in bituminous mixer form ductile thin film around the aggregatesso that the physical interlocking of the aggregate is improved. This serves as a better physical looking of the aggregate. The binder material which does not possess sufficient ductility will crack and spoil the pavement surface. The type of bitumen and its use is the best way for judging its suitability. Low ductility value results in cracking of pavement mostly in cold weather. The right ductility value of bitumen binder is required for making good highways

Description of Procedure:

Melt the bitumen to a temperature between 75 to 100℃ above its softening point still until it is completely fluid and free from air bubbles. Strain the fluid through IS Sieve 30 after stirring the fluid, pour it into the mound assembly and place it on the brass plate. To prevent the material under test from sticking, coat the surface of the plate and interior surfaces of the sides of the mound with a mixture 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℃ for half an hour. Remove the sample and mound assembly from the water bath and trim the specimen by levelling the surface using a hot knife. Replace the mound assembly in water bath maintained at 27℃ for 80 to 90 minutes. Remove the sides of the mould adjust the pointer to read zero. Run the machine and note the distance at which the bitumen thread of specimen breaks. Record the observations in the preformed and compute the ductility value. Report the mean of the two observations, rounded to nearest whole number as the 'Ductility value'.

Fig: Ductility Test Apparatus

Fig. Briquette mould

4.Flash Point and Fire Point

Flash Point: The flash purpose of a cloth is that the lowest temperature at that the application of check flame causes the vapours from the fabric momentarily catch fire within the type of a flash below given conditions of check.

Fire Point: the fireplace purpose is that the lowest temperature at that the applying of test flame causes the fabric to ignite and burn a minimum of for five s below given At higher temperatures hydrocarbon materials skip volatiles. These So, they will catch the fireplace simply and can cause flash at one purpose and if it's additional liable to heat the fabric could ignite Catching fireplace is incredibly dangerous throughout commixture of hydrocarbon particularly So, it's necessary to acknowledge the safe temperature values of hydrocarbon grades for commixture additionally as for applying

Description of Procedure:

1) Clean and dry all elements of cup and its accessories completely. with the fabric to be tested up to the extent indicated by the filling mark.
2) Place the lid on the cup and set the later within the stove.- Thermometer lightweight and modify the take a look at flame so it's of the scale of
3) Apply heat such the temperature rises at the speed the speed the speed per minute. flip the stirrer at the speed of roughly sixty revolutions per
4) Apply the take a look at flame by in operation the device dominant the shutter and test flame burner so the flame is lowered in zero.5 second, left in its lower position for one second, and quickly raised to its high position.
5) Discontinue stirring throughout the appliance of take a look at flame. flame at first at a temperature at first below the expected flash purpose.
6) There when applying the take a look at flame at associate degree interval of 1℃ for the vary above higher than increase this interval to 2℃.
7) author the Flash purpose at the temperature at that the flame

Fig. Pensky Martens Apparatus

Recommended Values:

For any type of Bitumen grade

1. Minimum Flash point value should be = 175℃
2. Minimum Fire point value should be = 175℃ + 5℃.

3. CONCLUSION

1) The serviceability and resistance to moisture will also be better when compared to the conventional method of construction.
2) The polymer modifier bitumen show better properties for road construction and plastic waste which otherwise are considered to be a pollution menace.
3) When addition of modifier waste plastic and crumb tyre having very good resistance toward potholes formation.
4) Use of plastic waste and crumb tyre as an asphalt mix modifier result it's safe ,useful and Eco- friendly disposal.

ACKNOWLEDGEMENT

We are sincerely acknowledge to Asst.Prof .S. A. Wankhade for their guidance and giving us huge motivation and encouragement supports us on every step towards the completion of the project and formal exposition of a subject and showing your active interest in our efforts .Thanks for giving suggestion to any kind of problem at each stage

REFERENCES

1. M. Abukhettala, ottawa, canada-may 5-6,2016,'' use of recycled material in road construction ,''paper 138
2. A review on usage of waste plastic(polyethelene) in construction of flexible pavement
3. Comprehensive literature review on use ofwaste tyres rubber in flexible road pavement
4. Prof. S.b patil [1], prof .a. A. Lole[2],prof. N. U.bavane[3],prof. S.s.shinde[4],'' use of waste tire in road construction'',dec-2016,val:3,issue :12
5. Construction and building material,''journal homepage;www.elsevier .com/locate/conbuildmat.
6. Yash menaria[1],rupal sankhla[2],''use of aster plastic in flexible pavement . Green roads'',[1]poornima institute of engineering and technology,jaipur india'','[2]center for environmental planning and technology ,ahmedabad ,india email ; yash07meneria@gmail.com,rupal.sankhla71@gmail. comreceived 24 june 2015;accepted 6 september 2015;publish 9 sep 15

7. Azmat sheikh ,nabeel khan , faisal shah, devendra shukla, gaurav kale,''use of plastic waste in road constructin,''vol;2,issue;5
8. Vinoth.n'' use of plastic waste in road construction ''
9. IRC sp-53:2010, "guidelines on use of modified bitumen in road construction"