EXPERIMENTAL ANALYSIS OF E WASTE IN VIRGIN BITUMINOUS MIXES

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ABSTRACT: Now-a-days, the world facing a real challenge is disposal of solid waste in particular E- waste without inducing any environmental issues. Electronic waste accounts that obsolute, broken, surplus, and loosely discared electrical or electronic devices Today's asphaltic concrete pavements are expected to perform better as they are experiencing increased volume of traffic, increased loads and increased variations in daily or seasonal temperature over what has been experienced in the past. In addition, the performance of bituminous pavements is found to be very poor in moisture induced situations. Considering this a lot of work has been done on use of additives in bituminous mixtures and as well as on modification of bitumen. Research has indicated that the addition of mobile chips and waste LPDE plastic to asphalt binders helps to increase the interfacial cohesiveness of the bond between the aggregate and the binder which can enhance many properties of the asphalt pavements to help meet these increased demands. However, the additive that is to be used for modification of mix or binder should satisfy both the strength requirements as well as economical aspects. In this research work we will add LPDE plastic waste 4% by weight and mobile chips as an aggregate replacement as 10%, 15%, 20% and 25% by weight. To determine the best suitable and stable replacement of bitumen in construction industry.

Keywords: bitumen, plastic, mobile chips, stability, penetration, sample, ductility.

I. INTRODUCTION OF WORK

Main objectives of bituminous mix design are to find;

- To determine Optimum content of mobile chips in a suitable proportion of bitumen.
- To determine Sufficient strength to resist shear deformation under traffic at higher temperature.
- To determine the enhancement in tensility and ductility of sample using plastic waste.
- To determine the use of non-biodegradable waste in construction industry.
- To determine sufficient flexibility to avoid cracking due to repeated traffic load.

Aim of study:

A comparative study has been made in this investigation in SMA mixes with plastic content (4%) and mobile waste chips in different sample as 10%, 15%, 20% and 25%. The objectives of this investigation are to observe the followings;

Study of Marshall properties of mixes using both

- Mobile chips as aggregate replacement.
- Plastic waste as an bitumen replacement.

PREPARATION OF SAMPLE

The Methods followed during the preparation of SMA sample and all the other practice followed before taking it to the Marshall testing Machine to test for Stability and flow values are-

- Sampling of coarse aggregates and fine aggregates is done for 13mm STONE MATRIX ASPHALT composition as specified by IRC:SP-79.
- The aggregates are graded according to IRC:SP-79 then dried and about 1200 gm is weighed to obtain height of 63.5 + 1.3 mm when compacted in the mould.
- The aggregate is heated in the oven to a temperature of 150-160 °C temperature for 1 hour.
- The necessary quantity of bitumen is weighted and heated separately to temperature of 170-190 °C.
- Then aggregate contained is taken out and heated in a mixing bowl. The binder is then poured in it and manual mixing is done to obtain properly coated aggregate. The mixing temperature should be within the limit for the binder temperature.
- A washed mould of 101.6 mm diameter and 76.2 mm height is taken with base plate and an extension collar.
- A piece of filter paper is fixed in the bottom of the mould then the whole mix is poured into mould.
- The whole assembly of mould is then placed on the compaction pedestal and hammered 75 blows for no fibre and 50 blows for fiber with the help of 2500 g compacting hammer having falling height of 80 mm. The same treatment is given on the reversed side of the specimen by reversing the mould
- The specimen is then transferred from the mould to a smooth flat surface and allowed to cool to room temperature for 24 hours.
- Then the specimen is measured and weighed in air and then after paraffin wax coating weighed in water. After marking the specimen is stored for stability and flow measurements.
- Before performing the test on Marshall testing machine, each sample is kept in hot water bath for 30 min at temperature of 600C.

Fig.3.7- Mould setting

Fig.3.8 Bitumen Addition

The effect of polyethylene as admixture on the strength of bituminous mix with different filler and replacing some percentage of fine aggregate by mobile chips.

II. EXPERIMENTAL INVESTIGATION

The procedure followed for conducting the tests is as per outline of Marshall Method (ASTM: D-1559).

Marshall Tests for stability and flow are conducted on four specimens for each sample of bituminous mix

Marshal Properties have been determined for each mix with varying percentage 10, 15, 20 and 25%) of mobile chips & 4% LPDE.

In the present investigation an attempt is made to study the enhancement in the properties of Stone mix Asphalt (S.M.A) on adding mobile waste LDPE (mobile cover) & Chips at various proportion.

Experiments which were conducted are mentioned as follows:

For Aggregates

- Impact Value Test
- Flakiness Index Test
- Elongation Index Test
- Water Absorption Test

For Bitumen

- Specific Gravity Test
- Penetration Test
- Softening Point Test
- Flash Point and Fire Point Test
- Ductility Test

For stability

- Marshall Stability Value Test

AGGREGATE IMPACT VALUE TEST

To determine the impact value of aggregate

Toughness is the property of a material to resist impact. Due to traffic loads, the road stones are subjected to the pounding action or impact and there is possibility of stones breaking into smaller pieces. The road stones ought to along these lines be sufficiently intense to oppose crack under effect. A test intended to assess the sturdiness of stone i.e., the resistance of the stones to break under rehashed effects might be called an effect test for street stones. Affect test may either be completed on round and hollow stone examples as in Page Impact test or on stone totals as in Aggregate Impact test. The Page Impact test is not done now-a-days and has likewise been precluded from the overhauled British Standard for testing mineral totals. The total effect test has been institutionalized by the British Standard Institution and the Indian Standard Institution. The total effect esteem shows a relative measure of the resistance of total to a sudden stun or an effect, which in a few totals varies from its imperviousness to a moderate compressive load. The strategy for test covers the methodology for deciding the total effect estimation of coarse totals.

Preparation of sample

- The test ought to adjust to the accompanying reviewing:
  - Passing through 12.5mm IS Sieve 100%
  - Retention on 10mm IS Sieve 100%
- The specimen ought to be stove dried for 4hrs. At a temperature of 100 to 110oC and cooled.
- The measure ought to be around 33% full with the readied totals and packed with 25 strokes of the packing pole. A further comparative amount of totals ought to be included and a further packing of 25 strokes given. The measure ought to at last be filled to flood, packed 25 times and the surplus totals struck off, utilizing a packing pole as a straight edge. The net weight of the totals in the measure ought to be resolved to the closest gram (Weight 'A').

Procedure

- The measure of the effect testing machine ought to be settled solidly in position on the base of the machine and the entire of the test set in it and compacted by 25 strokes of the packing bar.
- The hammer ought to be raised to 380mm over the upper surface of the totals in the glass and permitted to fall uninhibitedly onto the totals. The test ought to be subjected to an aggregate of 15 such blows, each being conveyed at an interim of at the very least one moment.

FLAKINESS INDEX TEST

To determine Flakiness Index of given sample aggregates

The flakiness Index of aggregates is percentage by weight of particles whose least dimension (thickness) is less than 0.6 of their mean dimension if w= (w_1+w_2+w_3+….) is the total weight

Of the total weight of material passing through different thickness gauges W = Total weight of material (W_1+W_2+W_3+…)

$$\text{Flakiness Index} = \frac{(w1+w2+w3\ldots\ldots)}{(W1+W2+W3\ldots\ldots)} \times 100$$

The sample is sieved with sieves mentioned in the table the minimum of 200 pieces of each fraction to be tested are taken and weighted = W gm in order to separate flaky material such

Fraction is then gauged for thickness on a thickness gauge the width of the slot used should be of the dimension specified column (3) of Table for appropriate size of material. The measure of flaky material passing the gauge is weighed to a precision of no less than 0.1% of weight of test.

III. ELONGATION INDEX TEST

To determine Elongation index of given sample of aggregate

The Elongation Index of a total is the rate by weight of particles whose most prominent measurement (length) is more than (1.8 times) their mean measurements

- W = (w_1+w_2 + w_3 + ……..) is the total weight of material retained on different length gauge
- W = total weight of material = (W_1 +W_2 + W_3+…..)

$$\text{Elongation Index} = \frac{(w1+w2+w3\ldots.)}{(W1+W2+W3\ldots.)} X100\%$$

The weight of each fraction of aggregates passing and retained on specific sieves size are found (W_1.. W_2…W_3…) and the total weight of sample = (W_1 + W_2 +W_3……) = Wgm is determined.

IV. RESULTS

STABILITY TEST:

Marshall stability test:

From this study the following results are obtained which is shown in following Tables Marshall Properties of various Bituminous Mixes and marshal curves for this design mix shown from the below figures are as follows: In all cases 4% plastic obtained from mobile case is utilized as a bitumen replacement whereas 10%, 15%, 20% and 25% mobile chip is utilized for replacing aggregate in a stone mix asphalt sample

Table 5.1: Marshall Properties of various Bituminous Mix:

Sr. No.	Type of Mix	Flow Value	Va (%)	VMA (%)	VFB (%)	Marshall Stability value (kg)
1.	SMA mix with 10 % chips as a aggregate replacement	3.5	4.4	7.75	70.3	1560
2.	SMA mix with 15 % chips as a aggregate replacement	3.8	2.43	8.28	69.80	1640
3.	SMA mix with 20 % chips as a	4.1	3.0	9.48	68.3	1700
	aggregate replacement					
4.	SMA mix with 25 % chips as a aggregate replacement	4.0	2.8	8.85	68.9	1686

Penetration test:

Penetration of a bituminous material is the distance in tenths of millimeter that standard needle will penetrate vertically into a sample under standard conditions of temperature, load and time. As per I.S. Code IS: 1203 – 1978

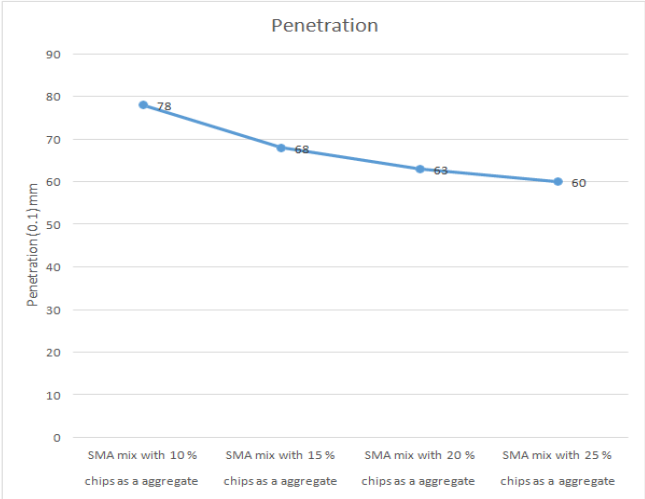

Table: 5.2 penetration test

PENETRATION TEST		
S.No.	**Standard value**	**Test result**
SMA mix with 10 % chips as a aggregate replacement	**60-70 (0.1) mm**	**78**
SMA mix with 15 % chips as a aggregate replacement		**68**
SMA mix with 20 % chips as a aggregate replacement		**63**
SMA mix with 25 % chips as a aggregate replacement		**60**

Ductility test:
This test is done to determine the ductility of distillation residue of cutback bitumen, blown type bitumen and other bituminous products as per IS: 1208 – 1978. The principle is : The ductility of a bituminous material is measured by the distance in cm to which it will elongate before breaking when a standard briquette specimen of the material is pulled apart at a specified speed and a specified temperature. As the chips percentage increases, the tensile strength of the sample and ductility increase with increase ratio of sample.

DUCTILITY TEST		
S.No.	**Standard value**	**Test result**
SMA mix with 10 % chips as a aggregate replacement	**75 cm (min.)**	**100**
SMA mix with 15 % chips as a aggregate replacement		**101.5**
SMA mix with 20 % chips as a aggregate replacement		**103.43**
SMA mix with 25 % chips as a aggregate replacement		**104.3**

Table 5.3: Following results were obtained from the other tests conducted on bitumen

Sr. No.	Property	Specification of IS:73	Test Result
1.	Specific Gravity	0.99 (min)	1.025
3.	Softening Point	45-55 °C	50

Overall results

Sr. No.	Type of Mix	Flow Value	Ductility test	PENETRATION TEST	Marshall Stability value (kg)
1.	SMA mix with 10 % chips as a aggregate replacement	3.5	100	78	1560
2.	SMA mix with 15 % chips as a aggregate replacement	3.8	101.5	68	1640
3.	SMA mix with 20 % chips as a aggregate replacement	4.1	103.43	63	1700
4.	SMA mix with 25 % chips as a aggregate replacement	4.0	104.3	60	1686

V. CONCLUSION

In this dissertation work we presented the study of waste polythene recycling in construction industry where till date use of LPDe polythene has been done but with the help of this study, here we are concluding that use of mobile chips is also possible in construction industry as LPDe shows low tensile strength thus ductility is low as well as binding decreases. But in this study we stated that with the use of mobile case polythene in a fixed proportion. we can increase mobile chips proportional of the sample as well as the binding property of the sample aslo increases.
This study is valuable for highway construction as it can help in settling the non-biodegradable waste as well as increases bitumen (flexible) pavement life.

From the above tests conducted the following conclusions were drawn out:-

- Utilization of e-waste in road construction will be useful for two purposes: firstly it will reduce the cost of construction and secondly it will contribute towards an effective management of e-waste.It is observed that by addition of mobile chips to the mixture, the resistance to moisture susceptibility of mix also increases. BC with polyethylene results in highest tensile strength ratio in SMA mix.
- From the study it is concluded that mobile case increases the binding property of the mix in a natural way.
- The ductility of the sample increases with increase in mobile chips as it provides good tensile strength to the sample.
- As per the cost cutting in construction this method is very valuable and as it is very helpful in cost cutting of bitumen in a mix.

Future Scope:
Some limitations of the present study and future scope in this area were sighted below. This study has been limited to the design procedures for SMA. So, other suitable procedures should be developed for different mixes. The performance study of stone mix is primarily based on analysis of Marshall Stability and air void content in the compacted hot mix. The mix performance characteristics in terms of many other engineering properties need to be considered.

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