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# USE OF PLASTIC COATED AGGREGATES IN ROAD CONSTRUCTION

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***Abstract:*** **The studies on the use of polymer bitumen for flexible pavement are being carried out.Virgin & recycled polymers area unit getting used for these studies. Use of disposed plastics waste is that the would like of the hour.The studies on the thermal behavior and binding property of the melted plastics promoted a study on the preparation of plastics waste – hydrocarbon mix and its properties to find the suitableness of the mix for construction.The blend is almost similar to plastic bitumen.But, once a higher proportion of plastics waste was used, the chemical compound got separated from the mix.A changed technique was developed and also the stone mixture was coated with melted plastics and also the plastics waste coated mixture was used because of the material for versatile construction. Plastic coated aggregate showed better binding property. It had less wetting property. Its voids were much less. The sample showed higher Marshall Stability value,(irc.gov.ic.in.sp.098.2013). The roads laid using plastic coated aggregate are performing well. A detailed studied is presented.**

***Keywords:*** **Waste Plastic, Bitumen, Flexible pavment, Marshall test.**

## I. INTRODUCTION

Nowadays disposal completely different of various wastes created from different Industries could be a nice drawback. These materials cause environmental pollution within the near vicinity as a result of several of them area unit non-biodegradable. Traditionally soil, stone aggregates, sand, bitumen, cement, etc. are used for road construction. Natural materials being exhaustible in nature, its amount is declining bit by bit. Also, the price of extracting smart quality of natural material is increasing. Concerned about this, the scientists are looking for alternative materials for highway construction, and industrial wastes product is one such category. If these materials are often fittingly utilized in main road construction, the pollution and disposal issues could also be partially reduced. In the absence of different shops, these solid wastes have occupied several acres of land around plants throughout the country. Keeping in mind the necessity for bulk use of those solid wastes in India, it was thought expedient to test these materials and to develop specifications to enhance the use of those industrial wastes in road creating, in which higher economic returns may be possible. The potential use of those materials ought to be developed for the construction of low volume roads in several elements of our country. The necessary specifications ought to be developed and make an attempt area unit to be created to maximize the employment of solid wastes in several layers of the road pavement.

Post construction pavement performance studies area unit to be finished these waste materials for construction of low volume roads with two-fold benefits:

(a) it'll facilitate clear valuable land of big dumps of wastes;

(b) it'll conjointly facilitate to preserve the natural reserves of aggregates, therefore protective the surroundings.

Plastics area unit user-friendly however not eco-friendly as they're non-biodegradable typically, it is disposed of by way of landfilling or incineration of materials which are hazardous. Plastic is flexible material and an acquaintance to an individual becomes a haul to the surroundings when its use. The better binding property of plastics in its molten state has helped in finding out a method of safe disposal of waste plastics. Road surface with neat hydrocarbon will cause hemorrhage in a hot climate, might develop cracks in cold climate, possess fewer hundreds bearing capability and might cause serious damages thanks to higher axle load in gift conditions because of speedy infrastructure development. The

useful life of bituminous overlays has reportedly declined 7-8 from average life of 5-6 years in the past to about 3-4 years at present as compared to average pavement life (5-6 years ) in abroad. India has got to raise installation to a better level each in terms of length and quality.

## II. MAJOR FORMAT GUIDELINES

### *A. Methodology*

**BASIC PROCESS:-**

1. Segregation:- Plastic waste collected from various sources must be separated from other waste. Maximum thickness is 60 microns.


**Fig 1: Segregation of plasic**

2. Cleaning Process :-Plastic wastes get cleaned and dried

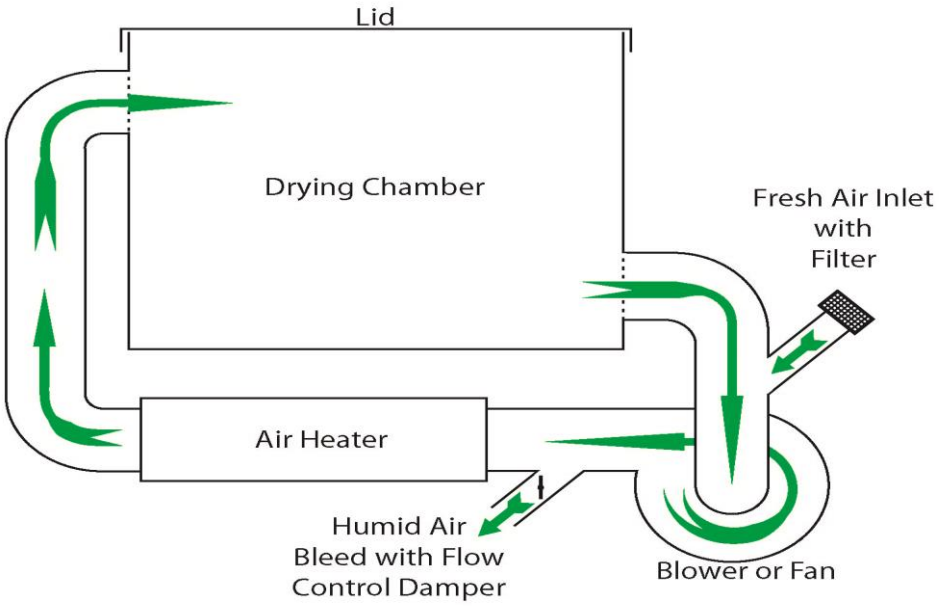


**Fig 2: Cleaning & drying of plastic**

3. Shredding process:-Will be shredded or cut into small piece. The different types of plastic wastes are mixed together

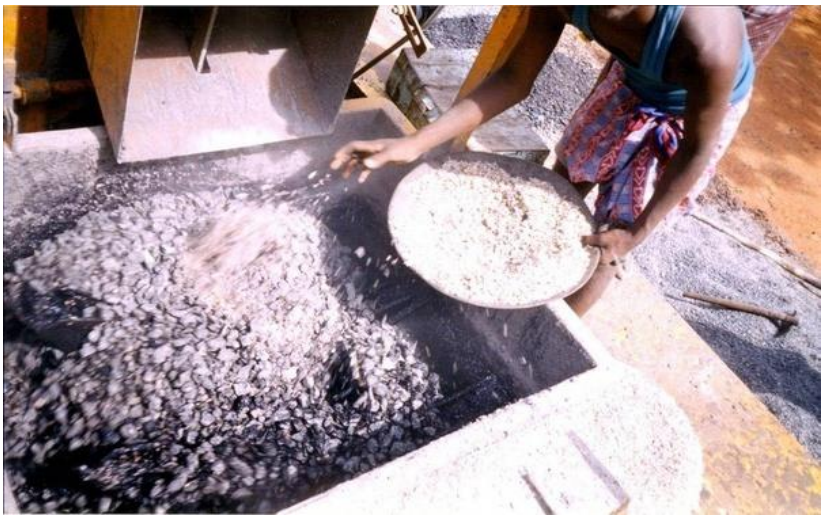

**Fig 3: Mixing of plastic**

4. Collection process:- The plastic waste retaining in 2.36 mm is collected.

***Dry process:***

Mixing the appropriate quantity of dry shredded waste plastic with hot aggregate prior to production of bituminous mixes at hot mix plant by varying percentage of plastic by weight of the mix.

(i) Various types of waste plastic are collected, analyzed as per their type and sent for storage.

(ii) These segregated wastes are then cleaned and dried to remove impurities from them.

Then take away size of one.18-4.36 mm using shredding machine, (PVC waste should be eliminated).

(iii) The aggregate mix is heated to 165°C (as per the HRS specification) and transferred to the mixing chamber.

Similarly, the hydrocarbon is to be set to a most of 160°C (HRS Specification) to possess smart binding and to stop weak bonding.

(Monitoring the temperature is very important).

**RESULT:**

1)MATERIALS:

a)Bitumen VG-30 grade

b)20mm aggregate sample(3/4")

c)10mm aggregate sample

d)06mm aggregate sample

e)Crushed Sand

f)Filler(Stone Dust)

2.LABORATORY TEST RESULTS:

a)Sieve Analysis :Table1

b)Physical properties of aggregates :Table 2

c)Bitumen :Table 3

d)Combined grading aggregates :Table 4

e)Marshall test :Table 5

f)Confirmity test results :Table 6

3.JOB MIX FORMULA:

For D.B.M the blending proportion to be taken as follows:

a)Bitumen VG-30 grade :4.82%by weight w.r.t. Blended aggregates

:4.50%by weight w.r.t. Total mix

b) 20mm Aggregates :42%by weight

c) 10mm Aggregates :08%by weight

d) 06mm Aggregates :08%by weight

e) Crush Sand :40%by weight

f) Filler(Stone Dust) :02%by weight

**NOTES:** 1)This above job mix formula test results are based on the materials as received in the laboratory vide customer's requisition referred and tests carried out accordingly.

2)In case of a change in sources, gradation proportions, specifications, necessary modification are to be done in the above job mix formula during execution at the site in order to satisfy the specified requirements/design criteria

**Table 1: SIEVE ANALYSIS TEST OF AGGREGATES FILLER**

| Sr no. | Sieve size (mm) | Material % passing | | | | | Reference |
|---|---|---|---|---|---|---|---|
| | | 20mm | 10mm | 06mm | Crushed sand | Filler (stone dust) | |
| 1. | 17.5 | 100 | 100 | 100 | 100 | 100 | IS:2386(Part-1)-1963 |
| 2. | 26.5 | 100 | 100 | 100 | 100 | 100 | |
| 3. | 19 | 82 | 100 | 100 | 100 | 100 | |
| 4. | 13.2 | 12 | 90 | 100 | 100 | 100 | |
| 5. | 4.75 | 0 | 1 | 52 | 100 | 100 | |
| 6. | 2.36 | 0 | 0 | 10 | 78 | 100 | |
| 7. | 0.600 | 0 | 0 | 2 | 42 | 100 | |
| 8. | 0.300 | 0 | 0 | 1 | 27 | 98 | |
| 9. | 0.150 | 0 | 0 | 0 | 18 | 96 | |
| 10. | 0.075 | 0 | 0 | 0 | 6 | 86 | |

**Table 2:**

| Sr no. | Sieve size (mm) | Results limits (%) | | | | | Specified limits as per MORTH table 500-17 | References |
|---|---|---|---|---|---|---|---|---|
| | | 20mm | 10mm | 06mm | Crush sand | Filler (stone dust) | | |
| 1. | Los angeles abrasion value (%) | - | - | - | - | - | Max 35% | IS 2386(Part - 4) 1963 |
| 2. | Impact value (%) | 8 | 11 | - | - | - | Max 27% | IS 2386 (part-4) 1963 |
| 3. | Combined flakiness & elongation indices(%) | 11 | 15 | - | - | - | Max 35% | IS 2386(Part - 4) 1963 |
| 4. | Coating & stripping of bitumen agg mixture(%) | 96 | 97 | - | - | - | Min retained coating 95% | IS 6241-1971 |
| 5. | Water absorption(%) | 1.09 | 1.16 | 1.20 | 3.20 | - | Max 2.00% | IS 2386(Part - 3) 1963 |
| 6. | Specific gravity | 2.88 | 2.875 | 2.84 | 2.78 | 2.82 | - | IS 2386(Part - 3) 1963 |
| 7. | Plasticity index | - | - | - | NP | - | Max 1% | IS-2720 (Part 5) |

**Table 3: TEST RESULTS OF BITUMEN**

| Sr.No | Test | Results | Specified Limits for Grade VG 30 as per IS:73:2006 | Reference |
|---|---|---|---|---|
| 1. | Softening point (°C) | 49.40 | Min-47 | IS:1205-1978 |
| 2. | Penetration at 25°C, 100gm,110mm | 53 | 50-70 | IS:1203-1978 |
| 3. | Specific Gravity | 1.01 | - | IS:1202-1978 |
| 4. | Flash Point (°C) | 262 | Min 220 | IS:1209-1978 |
| 5. | Ductility(Cm) | 100 | Min 40 | IS:1208-1978 |

**Table 4: COMBINED BLEND**

| Sr no. | Sieve size (mm) | %passing by weight | | | | | Total Cummulative % passing | (%) Specified Grading No-2 Limits as per MORTH Table no 500-10 |
|---|---|---|---|---|---|---|---|---|
| | | Blending Proportions | | | | | | |
| | | 20mm | 10mm | 06mm | Crush sand | Filler (stone dust) | | |
| | | 42% | 8% | 8% | 40% | 2% | | |
| 1. | 37.5 | 42 | 8 | 8 | 40 | 2 | 100 | 100 |
| 2. | 26.5 | 42 | 8 | 8 | 40 | 2 | 100 | 90-100 |
| 3. | 19 | 34 | 8 | 8 | 40 | 2 | 92 | 71-95 |
| 4. | 13.2 | 5 | 7 | 8 | 40 | 2 | 62 | 56-80 |
| 5. | 4.75 | 0 | 0 | 4 | 38 | 2 | 44 | 38-54 |
| 6. | 2.36 | 0 | 0 | 1 | 31 | 2 | 34 | 28-42 |
| 7. | 0.300 | 0 | 0 | 0 | 11 | 2 | 13 | 7-21 |
| 8. | 0.075 | 0 | 0 | 0 | 2 | 2 | 4 | 2-8 |
| 9. | Pan | - | - | - | - | - | - | - |

**Table 5: MARSHALL TEST RESULTS**

As the all values of result are mentioned in table no.5. The range of value is optimum of all the above readings selected for design of bitumen content.

| Sr No. | % By weight w.r.t mix | Stability(kg) | Marshall flow value(mm) | Remarks |
|---|---|---|---|---|
| 1. | 6-8% | 1276 | 3.30 | Designed for optimum content |
| 2. | 10% | 1342 | 2.95 | |
| 3. | 12% | 1280 | 4.20 | |

**Table 6: TRIAL AT OPTIMUM BITUMEN CONTENT**

| Sr No. | Test (Parameters) | Results | Specified limits for as per MORTH for DBM. Table no: 500-11 |
|---|---|---|---|
| | | As per physical testing | |
| 1. | Stability (Kg) (75 blows on each of the two faces of specimen) | 1300 | 900 |
| 2. | Marshall Flow(mm) | | 224 |
| 3. | Voids in mineral agg (%) | 15.22 | 11.82 |
| 4. | Air voids in mix | 3.82 | 3-5 |
| 5. | Voids in combined agg filled with bitumen (%) | 74.90 | 65-67 |
| 6. | Binder content by weight of total mix (%) | 4.50 | Min 4.5 |
| 7. | Compacted density of mix (g/cc) | 2.515 | - |
| 8. | Gmm | 2.615 | - |
| 9. | Marshall Quotient | 3.58 | 2-5 |
| 10. | F/B | 0.87 | 0.60-1.20 |

***C. Conclusion***

ADVANTAGES:

TECHNICAL:-

• No stripping and no potholes.

• Stronger road with increased Marshalls stability.

• Increase in binding and better bonding.

• Better resistance towards rainwater and stagnation.

SOCIO-ECONOMY:-

• Environmental benefits.

• Municipal solid waste management.

• Employment generation.

• Farming community.

• National economy

DISADVANTAGES:

• Toxins present in the co-mingled plastic waste would start leaching during the cleaning process.

• It causes somewhat pollution.

APPLICATIONS:

• It is a useful material in road construction.

• Waste can be recycled and used.

• Develop a technique which is eco-friendly.

• Generate job for rag pickers.

• It shows that with the increase in plastic waste in bitumen increases the properties of aggregate and bitumen.

## III. CONCLUSION

1. Plastic can increase the temperature of the hydrocarbon.

2. This innovative technology not solely reinforced the construction however additionally increased the road life.

3. The life expectancy of a plastic polymer road as compared to a normal road is at least 100% more.

4. Plastic roads would be a boon for India's hot and intensely wet climate, where temperatures frequently cross 50 degrees and torrential rains create havoc, leaving most of the roads with big potholes.

5. It is hoped that in the near future we will have strong, durable and eco-friendly roads which will relieve the earth from all type of plastic-waste.

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