International Journal For Technological Research In Engineering
Volume 6, Issue 10, June-2019 *ISSN (Online): 2347 - 4718*

EXPERIMENTAL INVESTIGATION OF PLASTICWASTES FOR ROAD CONSTRUCTION

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Abstract: ***The utilization of plastic waste in bituminous mixes enhances its properties and also its strength in addition, it will also be a solution to plastic disposal and various defects in pavement i.e. pot holes, rut etc.The waste plastic used are polyethylene, polystyrene, polypropylene. The optimum plastic content for 60/70 and 80/100 grade bitumen was 8%. For both 60/70 and 80/100 grade bitumen with plastic content 8%, the maximum stability was achieved in 80/100 grade bitumen. There is an increase in stability with addition of PET plastic in asphalt mix.***
Keywords: ***Plasticwaste, road construction, bituminous roads, etc.***

I. INTRODUCTION

Plastic is everywhere in today s lifestyle. The main problem is what to do with the plastic waste. Use of plastic waste which is non biodegradable is rapidly growing and researchers have found that the material can remain on earth for 4500 years unchanged and without degradation. This threat of disposal of plastic will not solve itself and certain practical steps have to be initiated at the ground level. On the other hand the road traffic is increasing with time hence there arises a need to increase the load bearing capacities earth for 4500 years unchanged and without degradation. This threat of disposal of plastic will not solve itself and certain practical steps have to be initiated at the ground level. On the other hand the road traffic is increasing with time hence there arises a need to increase the load bearing capacities of roads.

1.1JUSTIFICATION AND RELEVANCE OFRESEARCH

This research is very much relevance in the field of pavement material for the development of the roads in rural areas with the use of waste plastics as binding material with the help of the mixes of bitumen with some proportion. Lots of laboratory tests are to be carried out to justify the result and relevance of the use of waste plastic as a binding material for the development of rural roads.

Figure- Plastic Waste

1.2 SCOPE OF STUDY

- By using the different grade of bitumen, the performance might me improved subjected to experimental results.
- It will recycle/re-use lots of waste plastic materials and helps environment less pollution

It will have good water proofing quality

1.3 OBJECTIVE OF RESEARCH

The Primary objective of this research is to formulate few testing approach for the evaluation of strength offered by plastic waste mixes. But, basically there are few objectives of this research such as:

- Cost efficient pavement material
- To check the property of bitumen mix specimen
- To check the coating property of aggregate with waste plastic materials
- Early development of rural roads
- To provide adequate strength on small scale rural roads
- Encouragement of rag pickers for picking plastic wastes
- Making environment less harm from plastic waste

1.4 APPROACH AND METHODOLOGY

This research approach starts with the collection of different types of waste plastics to the performance evaluation of the material. The methodology is best explained with the flowchart as drawn be-

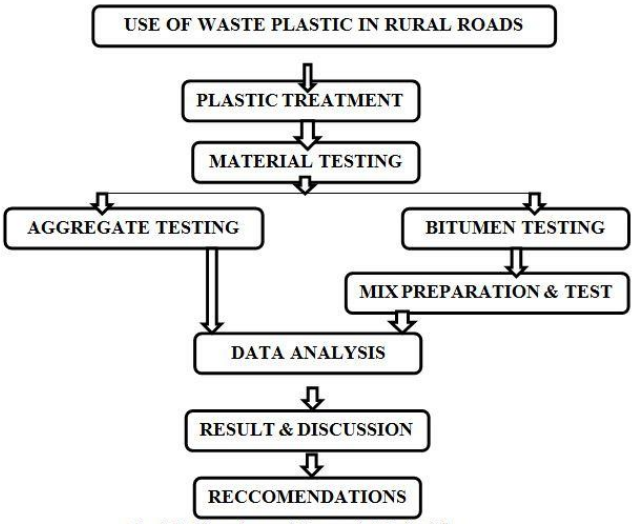


Fig.1.3. Flowchart of Research Methodology

II. LITERATURE REVIEW

PLASTIC WASTE USE IN ROAD CONSTRUCTION

Francis Atta Kuranchieet. al. (2019)In improving the aesthetics of the environment, the management of plastic wastes cannot be left out of the picture. Among the numerous ways that plastic wastes are managed, incorporating them into plastic roads is another viable option. This study quantified plastic wastes generation in Sunyani Municipality in Ghana and investigated the optimum percentage of asphaltic materials that could be made of plastic wastes for road construction in Ghana. Plastic Wastes were obtained from social gatherings, residential areas and restaurants, there was dialogue with key persons in the plastic industry and various experiments were also conducted for plastic wastes utilization in road construction. It was found that only one entrepreneur recycles the plastic wastes to make bags, dustbins, ropes and many more in the Municipality. It was also estimated that plastic wastes generation in the municipality per capita was 49.7 g/person/day whiles the total plastic wastes generated in the Municipality was 6,725.64 kg/day.

In addition, numerous experimentations proved that it is possible to substitute about 10% of asphaltic road materials with plastic wastes as plastic coated aggregates (PCA) to meet the Ghana Highways Authority (GHA) standards for road construction. The novelty finding in this research is that substitution of about 10% or more of asphaltic road materials in Ghana with plastic wastes could bring economy and cost savings in both road construction and plastic wastes management in Ghana.

SasaneNeha .B.et. al. (2018)In this paper, we have discussed about the soil properties The waste plastic and its disposal is a major threat to the environment, which results in pollution and global warming. The utilization of plastic waste in bituminous mixes enhances its properties and also its strength. In addition it will also be a solution to plastic disposal & various defects in pavement viz., pot holes, corrugation, ruts, etc. the waste plastic used are poly-ethylene, poly-styrene, poly-propylene. The waste plastic is shredded & coated over aggregate & mixed with hot bitumen and resulted mix is used for pavement construction. This will not only strengthen the pavement and also increases to be considered in design of pavement, pavement design, process of construction flexible and plastic-smoke absorbent pavement.

KurmadasuChandramouli et al (2017) "Plastic waste: its use in the construction of roads" reported that asphalt concrete using polyethylene modified binders were more resistant to permanent deformation at elevated temperature and found improvement in stripping characteristics of the crumb rubber modified mix as compared to unmodified asphalt mix.

R Manjui . et al (2016) "Application of waste plastic as an effective construction material in flexible pavement" polyethylene as one sort of polymers is used to investigate the potential prospects to enhance asphalt mixture properties. The objectives also include determining the best type of polyethylene to be used and its proportion. Two types of polyethylene were added to coat the aggregate High-Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE). The results indicated that grinded HDPE polyethylene modifier provides better engineering properties. The recommended proportion of the modifier is 12% by the weight of bitumen content. It is found to increase the stability, reduce the density and slightly increase the air voids and the voids of mineral aggregate.

Anzar Hamid Mir (2015) "Plastic waste in pavement construction" studied the visco-elastic nature of binders and found that the complex modulus & phase angles of the binders, need to be measured, at temperatures and loading rates which different resemble climatic and loading conditions.

Vatsal Patel et al (2014) "Utilization of plastic waste in road" described that the effect of wax in bitumen can be reduced by adding EVA (Ethyl Vinyl Acetate), aromatic resin and SBS in the waxy bitumen. The addition of 4% EVA or 6% SBS or 8% resin in waxy bitumen effectively reduces the Susceptibility to high temperatures, bleeding at high temperature and brittleness at a low temperature of the mixes.

III. EXPERIMENTAL PROGRAM

- Selection of material
- Material Processing
- Material Testing
- Observations & Calculations
- Result & Discussion

3.1 SPECIFIC GRAVITY & WATER ABSORPTION TEST OBJECTIVE

To determine the specific gravity and water absorption of aggregates by using aggregate density basket.

APPARATUS

• Aggregate density basket
• Oven
• A container for filling water and suspending the basket
• Balance suitable for weighing of the sample container when suspended in water A shallow tray and two dry absorbent clothes

3.2 PENETRATION TEST

AIM:

- To determine the consistency of bituminous material
- To assess the suitability of bitumen for use under different climatic conditions and various types of construction

3.3MARSHALL TEST

Bituminous mixes (sometimes called asphalt mixes) are used in the surface layer of road and airfield pavements. The mix is composed usually of aggregate and asphalt cements. Some

types of bituminous mixes are also used in base course. The design of asphalt paving mix, as with the design of other engineering materials is largely a matter of selecting and proportioning constituent materials to obtain the desired properties in the finished pavement structure.

STEPS OF DESIGN

1. Select aggregate grading to be used.
2. Determine the proportion of each aggregate size required to produce the design grading.
3. Determine the specific gravity of the aggregate combination and asphalt cement.
4. Prepare the trial specimens with varying asphalt contents.
5. Determine the specific gravity of each compacted specimen.
6. Perform stability tests on the specimens.
7. Calculate the percentage of voids, and percent voids filled with Bitumen in each specimen.
8. Select the optimum binder content from the data obtained.
9. Evaluate the design with the design requirements.

IV. RESULT

Results of OBC for 60/70 grade bitumen and 80/100grade bitumen

Maximum stability = 12.606 Kn, at bitumen content = 5%

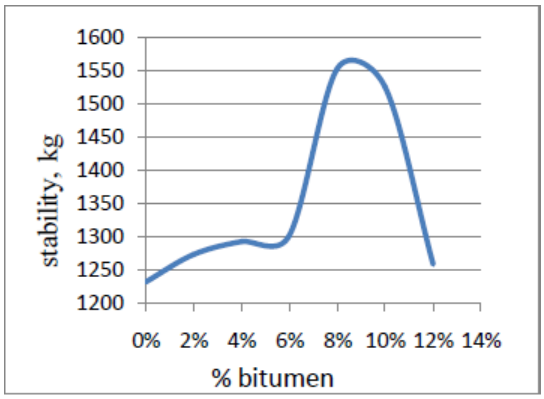
Maximum bulk density = 2.394gm/cc, at bitumen content = 5.5%

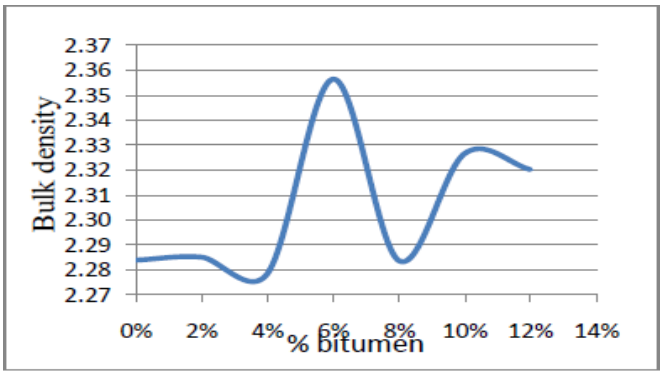
Percent air voids = 4% at bitumen content = 5.2%

Properties of bituminous mix after adding waste plastic for 60/70 grade bitumen

Table.4.11. Marshall Stability values Kg for BC Grade I for varying Waste Plastic %

Waste Plastic %	Gt	Gb	Vv	VMA	VFB	Vb	Stability Value, kg	Flow Value in 0.25mm
0	2.58	2.284	7.701	19.477	60.462	11.776	1231	5.7
2	2.57	2.285	7.563	19.326	60.865	11.763	1272	6
4	2.54	2.278	5.343	17.201	68.937	11.858	1291	6
6	2.52	2.356	5.558	17.273	67.823	11.715	1300	6
8	2.48	2.284	4.067	15.786	74.238	11.719	1552	6
10	2.46	2.327	3.776	15.446	75.549	11.668	1525	6
12	2.43	2.320	2.658	14.283	81.387	11.624	1258	5.7

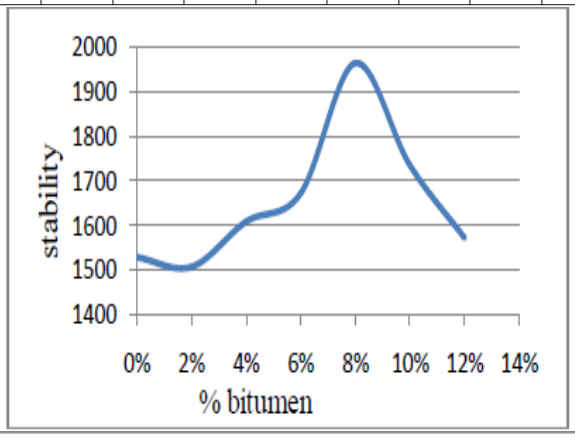


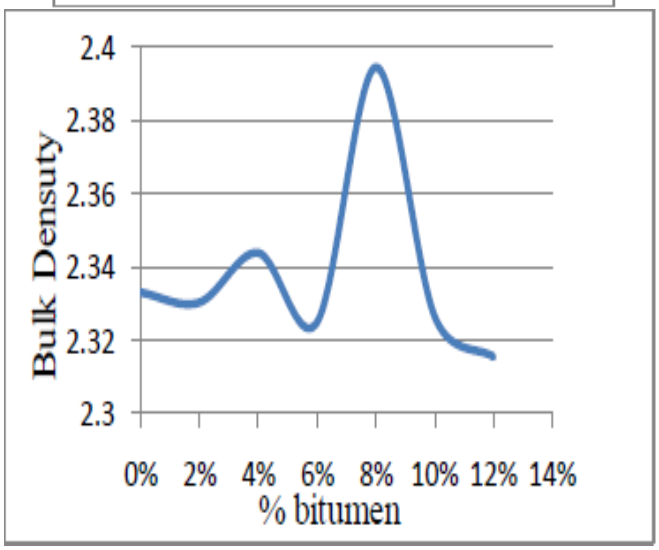


Properties of bituminous mix after adding waste plastic for 80/100 grade bitumen

Table.4.12. Marshall Stability values Kg for BC Grade I for varying Waste Plastic %

Waste Plastic, %	Gt	Gb	Vv	VMA	VFB	Vb	Stability Value, kg	Flow Value in 0.25mm
0	2.60	2.333	11.978	23.612	49.269	11.633	1529	5
2	2.56	2.330	9.139	20.892	56.255	11.753	1508	5
4	2.53	2.344	7.636	19.436	60.711	11.800	1609	4.7
6	2.51	2.325	6.492	18.295	64.518	11.803	1672	4.3
8	2.49	2.394	4.652	16.580	71.942	11.928	1963	4.7
10	2.46	2.326	5.842	17.505	66.627	11.663	1736	4.7
12	2.40	2.315	2.140	13.925	84.631	11.785	1573	4.3





Optimum bitumen content of 60/70 grade bitumen = 5.2%
Maximum stability = 17.334 Kn, at bitumen content = 5%
Maximum bulk density = 2.410gm/cc, at bitumen content = 5%
Percent air voids = 4% at bitumen content = 4.9%

V. CONCLUSION

- The optimum plastic content for 60/70 and 80/100 grade bitumen was 8%.
- For both 60/70 and 80/100 grade bitumen with plastic content 8%, the maximum stability was achieved in 80/100 grade bitumen.
- Wet process i.e. blending of plastic and bitumen cannot be carried out due to the plastic which is used has a very high melting point.
- There is an increase in stability up to 15% and 10% after adding waste plastic to the mix in 60/70 and 80/100 grade bitumen respectively.
- There is a decrease in stability value in water sensitivity test results. Unsoaked specimens show high stability value but soaked specimens showed a decreasing stability value.

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