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EXPERIMENTAL INVESTIGATION ON HDPE & PET IN CONSTRUCTION OF BITUMENOUS PAVEMENT (SURFACE COURSE)

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Abstract - *The waste plastic and its clearance is a major threat to the environment, which results in pollution and global warming. The exploitation of plastic waste in bituminous fusions enhances its possessions and also its strength. In addition it will also be elucidation to plastic dumping & several defects in pavement viz., pot holes, corrugation, ruts, etc. The waste plastic is shredded & glazed over aggregate & varied with hot bitumen and resulted mix is used for pavement construction. This will not only strengthen the pavement and also increases its durability. The key perseverance of this research to reduce bitumen content and by using plastic as effective binder in bituminous mix. In this paper we are improving bitumen possessions and diminish cost of construction and mainly plastic disposal so that environment expansion can attain and its eco-friendly and also here we are profitable to diverge PET and HDPE content from 10% to 50% to increase the Marshall stability strength of the road. By the experimental analysis we got 30% and 40% optimum values for PET and HDPE respectively.*

Key Words*: *(Urbanization, Bituminous Mix, Eco-Friendly, Non-Biodegradable, Deformation)

1. INTRODUCTION

The foremost danger to the environment is the discarding of waste plastic. A substantial that contain one or more organic polymer of bulky molecular encumbrance, solid in its completed state, can be molded by its drift is called as "plastic". Plastic is a non-degradable waste, causes greenhouse effect and global warming. The various experiments have been carried out whether the waste plastic can be reused productively. The various literature indicated that the waste plastic when added to hot aggregates will form a fine coat of plastic over the aggregate and such aggregates when mixed with binder is found to have higher strength, higher resistance and better performance over a period of time. Along with bitumen, use waste plastic increases its life and smoothness. It is economical and eco-friendly. Addition of plastic waste in construction of pavements reduces the plastic shrinkage and drying shrinkage. Use of waste plastic in the construction of flexible pavement shows good binding property and improves the bitumen's property because plastic acts as anti-striping agent and avoids the water percolation for the sub grade through surface course. Modified hot mix bitumen enriches pavement performance, safeguard atmosphere and provide low cost roads.

Objectives

1. To make use of the waste plastic as useful binding material.
2. Carry out marshal stability test on sample prepared with plastic.
3. To trim down the cost of material in construction of flexible pavement.

2. MATERIAL

i. Bitumen

Bitumen is firewood product obtained by refinement of crude oil. It is black, extremely viscous and semi sold material. 60/70 grade bitumen is used.

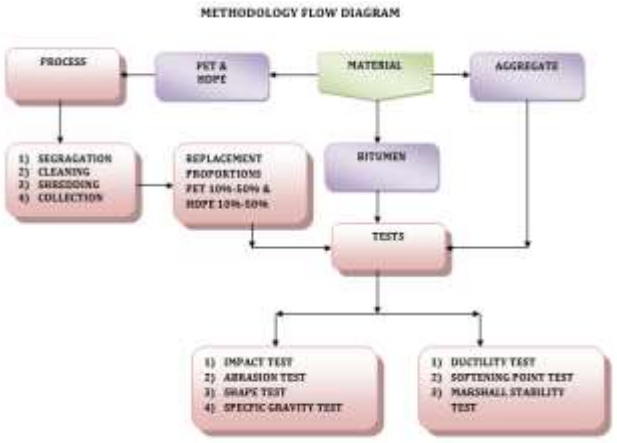
ii. Coarse Aggregates

Coarse aggregate is the major and prime material used in pavement construction. As it as good load bearing stresses and also resist to abrasive action of traffic movement under both dry and wet conditions when used in surface course of pavement.

iii. Plastic

Plastic usage is very collective and inevitability in everyday life. As it's very cheap, economic and easy to handle and carry. In India it's found that about 12-16kg of plastic is expended by per capita by per person. In plastic PolyEthylene Terephthalate (PET) and High Density polyethylene(HDPE) are the most important form it is long chain, semi crystalline thermo plastic it as high general properties and most common household things are made up of PET and HDPE as it is high durable, unchanging and easy to switch.

3. METHODOLOGY



In this paper we are using PET and HDPE as additional material with bitumen and material as undertaken segregation, cleaning, shredding, and collection and then replacement test of both aggregate and bitumen is carried out with proportions from 10%-50% to tests to increase strength.

4. EXPERIMENTAL RESULTS AND DISCUSSION

i. Tests on Aggregates

Aggregates are tested according to IRC codes and examined it with standard acceptable values

Table shows Test on Aggregate

Sl. no	Experiments	Results obtained	Acceptable Range
1	Impact Value	24.15%	10-20 (Strong) 20- 30 (Good)
2	Los-Angeles Abrasion Test	25.52%	<30%
3	Specific Gravity	2.7	2.5-3
4	Flakiness	10.3%	<35%
5	Elongation	33.60%	<35%

ii. Tests on Bitumen

Bitumen is tested according to IRC codes and examined it with standard acceptable values.

Table Tests on Bitumen

Sl.no	Experiments	Results obtained	Acceptance Range
1.	Ductility	57	40cm(Min)
2.	Ring & Ball Test (Softening Point)	53◦C & 54◦C	47°C(Min)

iii. Tests on Waste Coated Aggregates

Aggregates are coated with plastic at 100◦C as acts anti stripping agent on aggregate

Table shows Tests on Waste Coated Aggregates

Test on Aggregates	Natural Aggregate	PET Aggregate	HDPE Aggregate
Los Angeles Abrasion test	25.52%	24.56%	24.8
Impact test	24.52%	15.3%	17.24

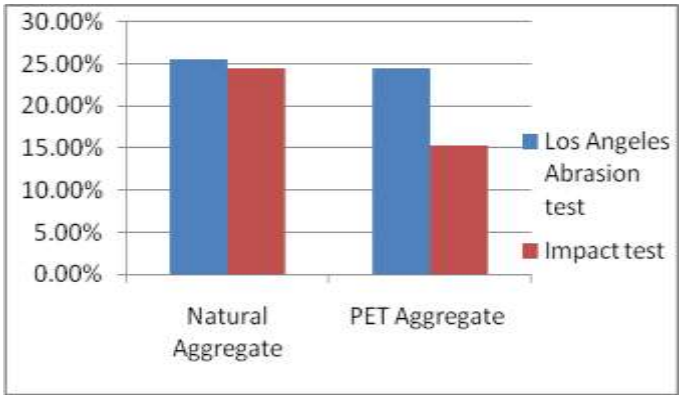


Chart 1: Tests on Coated Aggregates

iv. Tests on Replaced Bitumen

The bitumen test is lead and the analyses were tabularized. For the evaluations gained the following graphs are strategized compared to Bitumen and various parameters

a. Pet Replacement

PET is switched with bitumen in innumerable magnitudes like 10%-50% Marshall Stability test where conceded out for every single replacement of plastic magnitudes and annotation down the readings correspondingly

Table -1: Marshal Stability Test for PET replacement

PET %	Stability KN	Flow value mm
Bitumen	35.24	5.5
10	38.86	5
20	44.4	4.8
30	55.34	4.5
40	50.24	5
50	42.18	5.5

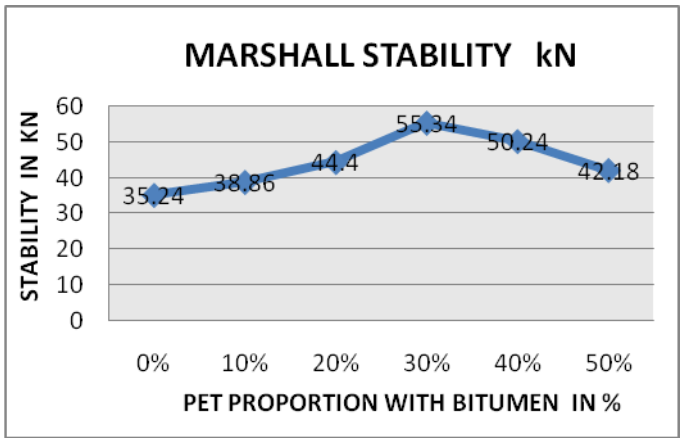


Chart -2: Stability Graph for plastic replacement

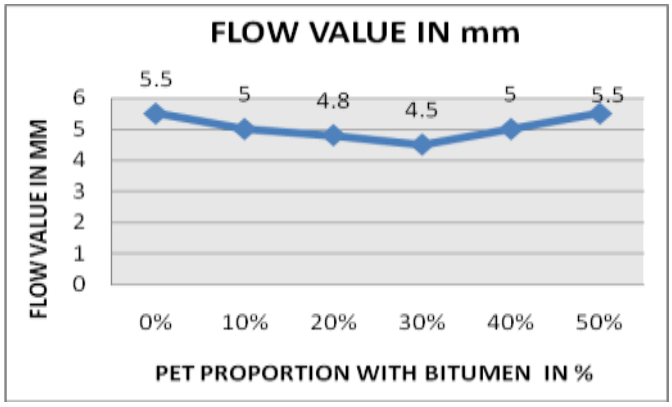


Chart -3: Flow Graph for plastic replacement

b. HDPE REPLACEMENT

HDPE is switched with bitumen in innumerable magnitudes like 10%-50% Marshall Stability test where conceded out for every single replacement of plastic magnitudes and annotation down the readings correspondingly

Table -1: Marshal Stability Test for HDPE replacement

PLASTIC%	Stability KN	Flow value mm
Bitumen	35.24	5.5
10	50.35	5
20	55.34	4.8
30	62.24	4.5
40	71.22	4.2
50	57.85	5

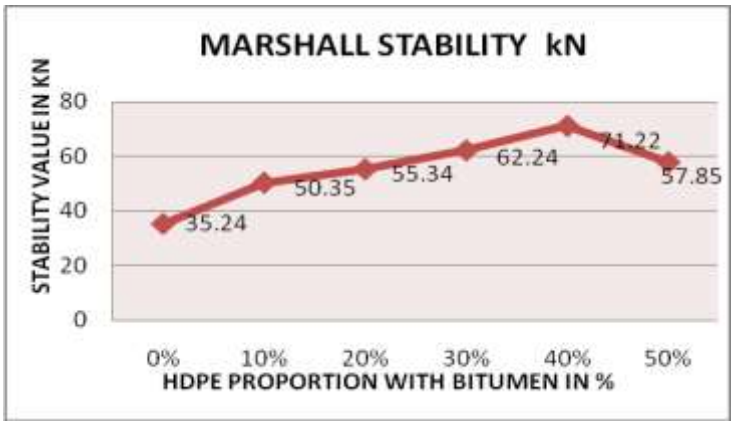


Chart -4: Stability Graph for plastic replacement

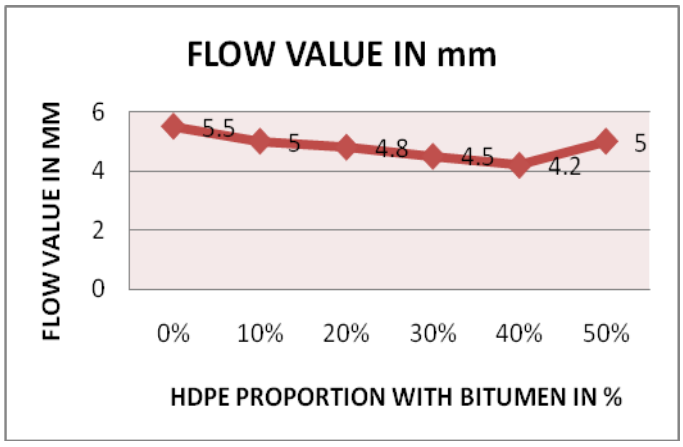


Chart -5: Flow Graph for plastic replacement

5. ESTIMATION AND COMPARISION

Material Needed	Plain Bitumen Process	PET-bitumen road	HDPE-bitumen road
60/70 Bitumen	30.8 tones	21.56 tones	21.56 tones
Waste	----------	9.24 tones	9.24 tones

Cost Rs.	3283500	2016080	2016080
Cost Reduced	NIL	1267420	1267420
Cost Reduction in %	**0%**	**38.6%**	**38.6%**
Stability kN	35.24	55.34	71.22
Stability increased by	0 times	1.57 times	2 times
Flow value decreased by	0 times	0.8 times	0.8 times

6. CONCLUSIONS

i. The above graphs describe about assorted content of bitumen and properties of behavior of marshal stability molds, shows positive outcome at 30% of for PET and 40% for HDPE waste content. Hence we can conclude that among 10%, to 50% .30% and 40% is the optimum.

ii. The thickness of the pavement layer may be decline to half of normal thickness which results in economy of cost by reducing quantity of aggregate, bitumen and by achieving the work in less duration of time with better quality.

iii. Due to use of waste stuff the cost reduction is up to 38.6% for both PET and HDPE. When compare to ordinary bitumen.

REFERENCES

[1] S.E. Zoorob, L.B. Suparma. (2000**). "Laboratory design and investigation of the properties of continuously graded Asphaltic concrete containing recycled plastics aggregate replacement (Plastiphalt)"**, Cement & Concrete Composites Vol. 22, School of Civil Engineering, (CEMU), The University of Leeds, UK

[2] Hınıslıoglu Sinan. Agar Emine, (2004) **"Use of waste high density polyethylene as bitumen modifier in asphalt concrete mix",** *Materials Letters,* Vol. **58**, pp. 267–271

[3] Hakeem Jan **"Plastic Bottles Waste Utilization as Modifier for Asphalt Mixture Production"** MATEC Web of Conference 103, 09007(2017) ISCEE 2016

[4] Mr.Yukab Ansari **"Replacement of Asphalt with Waste Polythene in Bitumen Road"** IJOARIAIIT, ISSN: 2454-132x, Volume 3, Issue 3, PP- 602-608

[5] Utibe J Nkanga **"Characterization of Bitumen/ Plastic Blends for Flexible Pavement Application"** SMPM 2017 23-25 January

[6] Yash Menaria **"Use of Waste Plastic in Flexible Pavements – Green Roads"** Open Journal of Civil Engineering, 2015, 5, 299-311

[7] Atul Uniyal **"Potential Use of Waste Plastic in Flexible Road Pavement"** IJIRTS, ISSN: 2321-1156

[8] Sumit G Dhundalwar, Ashish Moon, Vikas C. Patle, Saurabh K. Jaiswal**, "Use of Plastic Waste in Bituminous Road Construction"** International Journal Of Research In Science And Engineering Volume:3, Issue:2 March-April 2017.

[9] Vijay Rohilla, Paramjeet Malik **"Use of Waste High Polyethylene as Bitumen Modifier in Asphalt Concrete Mix"** (IJARESM) ISSN: 2455-6211, Volume 4, Issue 7, July -2016, Impact Factor: 2.287

[10] Mr. Dinesh M Sutar **"Feasibility of Plastic Coat Road with Respect to Cost and Their Performance"** IRJET Volume 3, Issue 12, Dec-2016, E-ISSN: 2395-0056, P-ISSN: 2395-0072.

[11] Minakshi Singhal **"Use of Modified Bitumen in Highway Construction"** IJIRST, Volume 2, Issue 12 May 2016 ISSN- 2349-6010