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Use of Waste Polyethylene in Bituminous Concrete Mixes

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Abstract:
Bituminous Concrete (BC) is a composite material mostly used in construction projects like road surfacing, airports, parking lots etc. It consists of asphalt or bitumen (used as a binder) and mineral aggregate which are mixed together & laid down in layers then compacted. Now a day, the steady increment in high traffic intensity in terms of commercial vehicles, and the significant variation in daily and seasonal temperature put us in a demanding situation to think of some alternatives for the improvisation of the pavement characteristics and quality by applying some necessary modifications which shall satisfy both the strength as well as economic aspects. Also considering the environmental approach, due to excessive use of politeness in day to day business, the pollution to the environment is enormous. Since the polythenes are not biodegradable, the need of the current hour is to use the waste polythene in some beneficial purposes. This paper presents a research conducted to study the behavior of BC mix modified with waste polythene. Various percentages of polythene are used for preparation of mixes with a selected aggregate grading as given in the IRC Code. The role of polythene in the mix is studied for various engineering properties by preparing Marshall Samples of BC mixtures with and without polymer. Marshall Properties such as stability, flow value, unit weight, air voids are used to determine optimum polythene content for the given grade of bitumen (80/100).

Keywords: Bituminous Concrete (BC), Marshall Stability, Flow value, Optimum Polythene Content.

I. INTRODUCTION

Bitumen is a useful binder for road construction. Different grades of bitumen like 30/40, 60/70 and 80/ 100 are available on the basis of their penetration values. The steady increase in high traffic intensity in terms of commercial vehicles, and the significant variation in daily and seasonal temperature demand improved road characteristics. Any improvement in the property of the binder is the needed. Today the availability of the waste plastics is enormous, as the plastic materials have become part and parcel of daily life. They either get mixed with Municipal Solid Waste and/or thrown over land area. If not recycled, their present disposal is either by land filling or by incineration. Both the processes have certain impact on the environment. Under this circumstance, an alternate use for the waste plastics is also the needed. Thinner polythene carry bags are most abundantly disposed of wastes, which do not attract the attending rag pickers for collection for onward recycling, for lesser value. Again, these polythene/polypropylene bags are easily compatible with Bitumen at specified conditions. The waste polymer bitumen blend can be prepared and a study of the properties can throw more light on their use for road laying. Bituminous binders are widely used by paving industry. A pavement has different layers. The main constituents of bituminous concrete (BC) are aggregate and bitumen. Generally, all the hard surfaced pavement types are categorized into 2 groups, i.e. flexible and rigid.

II. OBJECTIVE

Construction of highway involves a huge outlay of investment. An accurate engineering design can save considerable investment; as well, a reliable performance of the highway, can be achieved. The bituminous mix design aims to estimate the proportions of bitumen, filler material, fine aggregates, coarse aggregates & polythene to produce a mix which should have Sufficient workability so that there is no segregation under load

1. Enough strength to survive heavy wheel loads & tyre pressures.
2. Sufficient durability
3. Should be economical

III. TYPES OF MATERIAL USED

TYPES OF MIX

1. Hot mix asphalt concrete
2. Warm mix asphalt concrete
3. Cold mix asphalt concrete
4. Cut-back asphalt concrete
5. Mastic asphalt concrete or sheet asphalt

PLASTIC ORIGIN

TYPES OF WASTE PLASTIC:

- Low density polyethylene (LDPE)
- High density polyethylene (DHPE)
- Polypropylene(PP)
- Polystyrene(PS)
- Roamed Polystyrene
- Polyvinyl Chloride(PVC)

Low density polyethylene (LDPE):
Bags, sacks, bin lining and squeezable detergent bottles etc

High density polyethylene (DHPE):
Bottles of pharmaceuticals, disinfectants, milk, fruit juices, bottle caps etc

Polypropylene (PP):
Bottle cap and closures, film wrapping for biscuits, microwave trays for ready-made Meals etc.

Polystyrene (PS):
Yoghurt pots, clear egg packs, bottle caps.

Foamed Polystyrene:
Food trays, egg boxes, disposable cups, protective packaging etc

Polyvinyl Chloride (PVC):
Mineral water bottles, credit cards, toys, pipes and gutters: electrical fittings, Furniture, folders and pens: medical disposables; etc

IV. RAW MATERIALS USED &SPECIFICATIONS

1. Cement
2. Fine Aggregates
3. Coarse Aggregates
4. Concrete
5. Bituminous Binder
6. Mineral Filler
7. Polythene

Table.1. Gradation of Aggregates

SIEVE SIZE	% RETAINED
26.5 mm	--
19 mm	5
9.5 mm	25
4.75 mm	20
2.36 mm	15
300 µ	23
75 µ	7
Filler (Fly ash)	5

Table.2. Specific Gravity

Sl.No	Material	Specific Gravity
1	Coarse Aggregate	2.7
2	Fine Aggregate	2.6
3	Bitumen	1.02
4	Fly Ash	2.2
5	Polythene	0.905

Table.3. Dimensions of Marshall Sampling mould & hammer

APPARATUS	VALUE	WORKING TOLERANCE
MOULD		
Average internal diameter, mm	101.2	± 0.5
HAMMER		
Mass, kg	4.535	± 0.02
Drop Height, mm	457	± 1.0
Foot diameter, mm	98.5	± 0.5


Figure.1. Marshall Sampling Mould


Figure.2. Marshall Hammer


Figure.3. Marshall Moulds

Table.4. Amounts of Raw Materials

polythene %	wt of polythene	wt of aggregate
	Gm	gm
0	0	1140
0	0	1140
0	0	1140
1	11.4	1128.6
1	11.4	1128.6
1	11.4	1128.6
2	22.8	1117.2
2	22.8	1117.2
2	22.8	1117.2
3	34.2	1105.8
3	34.2	1105.8
3	34.2	1105.8
4	45.6	1094.4
4	45.6	1094.4
4	45.6	1094.4
5	57	1083
5	57	1083
5	57	1083

V. EXPERIMENTAL WORK

1. Preparation of samples
2. Void analysis
3. T e s t i n g

VI. RESULTS

Table.5. Marshall Stability Value (S)

Sample No.	Polythene %	No. of divisions (N)	Marshall Stability Value (S) kN
1'	0	460	13.66
2'	0	500	14.85
3'	0	490	14.56
1	1	490	14.56
2	1	470	13.96
3	1	480	14.26
4	2	490	14.56
5	2	480	14.26
6	2	500	14.85
7	3	520	15.44
8	3	530	15.74
9	3	520	15.44
10	4	570	16.93
11	4	600	17.82
12	4	620	18.41
13	5	540	16.04
14	5	520	15.44
15	5	550	16.34

Table.6. Marshall Flow Value

Sample no.	Polythene %	Initial Reading (I)	Final Reading (F)	Marshall Flow Value (F) mm
1'	0	3.1	7.3	4.2
2'	0	3.3	7.4	4.1
3'	0	3.3	7.4	4.1
1	1	3.5	7.0	3.5
2	1	3.2	7.9	3.7
3	1	4.1	7.3	3.2
4	2	3.9	7.0	3.1
5	2	3.7	6.7	3
6	2	3.2	6.3	3.1
7	3	3.9	7.1	3.2
8	3	3.0	5.8	2.8
9	3	3.1	6.0	2.9
10	4	2.8	5.3	2.5
11	4	2.6	5.5	3.3
12	4	3.3	6.1	2.8
13	5	2.9	5.5	2.6
14	5	3.2	5.9	2.7
15	5	3.3	6.2	2.9

MARSHALL STABILITY VALUE

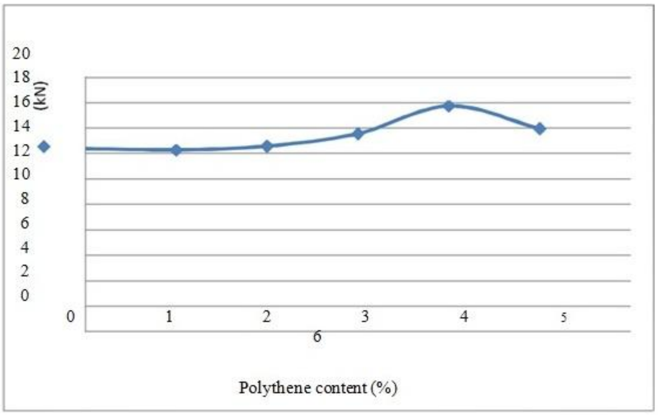

Figure.4. Marshall Stability value vs. Polythene content

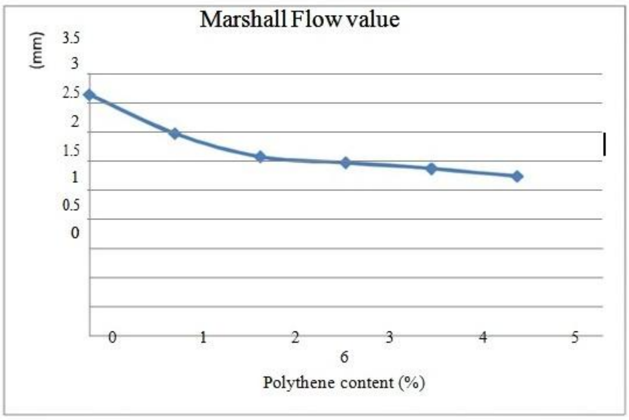

Figure.5. Marshall Flow Value vs. Polythene Content

VII. CONCLUSION

1. From the study of the behaviour of polythene modified BC it was found that the modified mix possesses improved Marshall Characteristics as mentioned below.
2. It is observed that Marshall stability value increases with polyethylene content upto 4% and thereafter decreases. we observe that the marshall flow value decreases upon addition of polythene i.e the resistance to deformations under heavy wheel loads increases. Also the values of the parameters like VMA, VA, VFB are within the required specifications.
3. Considering these factors we can assure that we can obtain a more stable and durable mix for the pavements by polymer modifications. This small investigation not only utilizes beneficially, the waste non-degradable plastics but also provides us an improved pavement with better strength and longer life period.
4. Polymer modified pavements would be a boon for India's hot and extremely humid climate, where temperatures frequently rises past 50°C and torrential rains create havoc, leaving most of the roads with heavy distresses. This adversely affects the life of the pavements. The polymer modified bitumen show improved properties for pavement constructions. This also can reduce the amount of plastics waste which otherwise are considered to be a threat to the hygiene of the environment.
5. In this modification process plastics-waste is coated over aggregate. This increases the surface area of contact at the interface and ensures better bonding between aggregate and bitumen. The polymer coating also reduces the void spaces present in the mix. This prevents the moisture absorption and oxidation of bitumen by entrapped air. The road can withstand heavy traffic and show better service life. This study will have a positive impact on the environment as it will reduce the volume of plastic waste to be disposed of by incineration and land filling. It will not only add value to plastic waste but will develop a technology, which is eco-friendly.
6. However, it is recommended that more research regarding the topic should be done and more trial sections should be laid and their performance should be studied.

VIII. REFERENCES

[1]. Annual Book of ASTM Standards, 1 9 9 9 . ASTM D-6373, Standard Specification for Performance Graded Asphalt Binder, pp: 1102-1136.

[2]. Aslam Shahan-ur-Rahman "Use of Waste Plastic in Construction of Flexible Pavement", New Building Materials & Construction World, 2009.

[3]. Bahia, H.U. And Anderson, D.A., Strategic highway research program binder rheological parameters: Background and comparison with conventional properties. Transport. Res. Rec. 1488, 1995, 32, 39.Vasudevan R., Nigam S.K., Velkennedy R., Ramalinga Chandra Sekar A., Sundarakannan B. Utilization of Waste Polymers for Flexible Pavement and Easy Disposal of Waste Polymers, International Conference on Sustainable Solid Waste Management, 5 - 7, Chennai, India pp-105-111, 2007. Baker, R.E., Polymer modified bitumen. Indian Highways, 1998, 1, 85–94.

[4]. Button, J.W. and Little, D.N., Additives Have Potential to Improve Pavement Life, 1998 (Roads and Bridges: USA).

[5]. Collins, J.H., Bouldin, M.G., Gelles, R. and Berker, A., Improved performance of paving asphalt by polymer modification. Proc. Assoc. Asphalt Paving Technol., 1991,60.

[6]. Das, A., (1998). Analytical design of bituminous pavements based on field performance, unpublished PhD thesis, Civil Engg. Dept., IIT, Kharagpur.

[7]. Denning, J.H. and Carswell, J., Improvement in rolled asphalt surfacing by the addition of organic polymers, Report LR 989, TRRL, Crowthrone 1981.

[8]. Justo C.E.G. and Veeraragavan A "Utilization of Waste Plastic Bags in Bituminous Mix for Improved Performance of Roads", Centre for Transportation Engineering, Bangalore University, Bangalore, India, 2002.

[9]. Palit, S.K., Reddy, M.A., Reddy, K.S. and Pandey, B.B., Performance evaluation of crumb rubber modified bituminous mixes. Proceedings of National Seminar on Road Transportation in India: Emerging Trends and Techniques, 2002 September 12–13 (IIT Kharagpur: India).

[10]. Pandey, B. B., "Bituminous Mix Design", A Two Day Workshop on Design of Flexible Pavement with Emphasis on the New IRC: 37-2001 Guidelines, 9-10 February, IIT Kanpur, 2002.

[11]. Shuler, T.S., Collins, J.H. and Kirkpatrick, J.P., Polymer modified asphalt properties related to asphalt concrete performance. In Asphalt Rheology Relationship to Mixture, ASTM, STP 941, edited by O.E. Briscoe, 1987 (ASTM: Philadelphia).