Laboratory Evaluation of usage of Crumb Rubber & Plastic Wastes in Asphalt Concrete Pavement

Tanuj Parmar[1], Pinal Patel[2], Tapan Patel[3], Hemil Patel[4], Smarika[5]

[1]Assistant Professor, Civil Engineering Department, Dr. S & S S Ghandhy Government Engineering College, Surat
[2,3,4,5]BE Civil Engineering Students, Dr. S & S S Ghandhy Government Engineering College, Surat

---

Abstract - *Plastics are easy to use however not eco-accommodating as they are non-biodegradable. For the most part it is arranged by method for land filling or cremation of materials which are perilous. The better restricting property of plastics in its liquid state has helped in discovering a technique for safe transfer of waste plastics, by utilizing them in street laying. Changed Bitumen is one of the vital development materials for adaptable asphalts. Utilization of plastic waste (LDPE) and Crumb Rubber i.e. the elastic got from the waste feels sick of vehicles, in the development of adaptable asphalt is picking up significance. It is additionally worth specifying that, the modifier crude material has been sourced from arranged waste plastic and scrap elastic. This not just enables us to gather modifier crude material easily, yet in addition gives an answer towards natural hazard presented by expanded utilization of plastics (non-biodegradable). In the present investigation, an endeavor has been made to utilize squander plastic, Low Density Polyethylene (LDPE) and Crumb Rubber, mixed utilizing dry process for LDPE and wet process for CRMB. Marshal strategy for bituminous blend configuration was done for shifting rates of LDPE and Crumb Rubber to decide the distinctive blend plan qualities.*

Key Words: **low density polyethylene, crumb rubber, Marshall Stability, flexible pavements**

1. INTRODUCTION

In India, it is assessed that more than 33 lakh kilometers of street exists. The street transport conveys near 90% of traveler activity and 70% of cargo transport. Examinations in India and nations abroad have uncovered that properties of bitumen and bituminous blends can be enhanced to meet prerequisites of asphalt with the consolidation of specific added substances or mix of added substances. These added substances are designated "Bitumen Modifiers" and the bitumen premixed with these modifiers is known as changed bitumen. Altered bitumen is relied upon to give higher existence of surfacing (up to 100%) contingent on level of adjustment and kind of added substances and change process utilized. Diverse kinds of modifiers utilized are Polymers, Natural Rubber and Crumb Rubber.

1.1 Waste scenario

The utilization of plastics have expanded from 4000 tons/annum (1990) to 4 million tons/annum (2001) and it is required to rise 8 million tons/annum amid the year 2009.

Almost 50 to 60% of the aggregate plastics are expended for pressing. When utilized plastic materials are tossed out. They don't experience bio-deterioration. Consequently, they are either arrive filled or burned. Both are not ecofriendly forms as they dirty the land and the air. Squander tires in India are sorted as strong waste or dangerous waste. It is evaluated that 60% of (retreaded) squander tires are arranged by means of obscure courses in the urban and in addition country zones. The perils of waste tires incorporate air contamination related with open consuming of tires (particulates, scent, visual effects, and other hurtful contaminants, for example, polycyclic fragrant hydrocarbon, dioxin, furans and oxides of nitrogen), stylish contamination caused by waste tire stores and unlawful waste tire gathering and different effects, for example, changes in hydrological administrations when chasms and waterways end up waste locales.

2. Literature Review

- Banglore Process (2002), contemplate with respect to plastic streets exhibited. A 25 km plastic street was laid in Bangalore. The plastic street indicated predominant smoothness, consistency and less rutting when contrasted with a without plastics street laid in the meantime, which started creating "crocodile splits" before long. The procedure was likewise affirmed in 2003 by the CRRI (Central Road Research Institute Delhi). Street life enhances through enhanced

cheapness and consistency of the bituminous blend, in this way restricting the stones all the more solidly together and enhancing the water-obstruction of the blend to rain and so on.

- Justo et al (2002), at the Center for Transportation Engineering of Bangalore University on the conceivable utilization of the handled plastic packs as an added substance in bituminous cement blends. The properties of the altered bitumen were contrasted and normal bitumen. It was seen that the infiltration and malleability estimations of the adjusted bitumen diminished with the expansion in extent of the plastic added substance, up to 12 % by weight. In this manner the life of the asphalt surfacing course utilizing the adjusted bitumen is additionally anticipated that would increment significantly in contrast with the utilization of customary bitumen.
- Mohammad T. Awwad et al (2007), polyethylene as one kind of polymers is utilized to examine the potential prospects to improve black-top blend properties. The goals additionally incorporate deciding the best kind of polyethylene to be utilized and its extent. Two sorts of polyethylene were added to coat the total High Density Polyethylene (HDPE) and Low Density Polyethylene (LDPE). The outcomes showed that crushed HDPE polyethylene modifier gives better designing properties. The prescribed extent of the modifier is 12% by the heaviness of bitumen content. It is found to build the steadiness, diminish the thickness and marginally increment the air voids and the voids of mineral total.
- Shankar et al (2009), scrap elastic altered bitumen (CRMB 55) was mixed at indicated temperatures. Marshall's blend configuration was completed by changing the altered bitumen content at consistent ideal elastic substance and consequent tests have been performed to decide the diverse blend plan qualities and for customary bitumen (60/70) moreover. This has brought about much enhanced attributes when contrasted and straight run bitumen and that too at lessened ideal altered cover content (5.67%).

3. OBJECTIVE

1. The physical properties of bitumen by conducting basic tests
2. The physical properties of aggregates by conducting basic tests to meet specifications
3. The physical properties of bitumen by conducting basic tests with added crumb rubber
4. Preparation of marshall moulds.

4. PROCEDURE AND TESTING

The Semi Dense Bituminous Concrete (SDBC) mix was prepared using Marshall Method of bituminous mix design. The SDBC was prepared with conventional 60/70 grade bitumen, 60/70 grade bitumen added with varying percentages of LDPE and 60/70 grade bitumen added with varying percentages of Crumb Rubber. The details of the experimental program are as follows.

Table 1 Detail of Sample Constitution and Percent Constituents

Sample Constitution	Sample Preparation	% Constituent by Weight of Bitumen
60/70 Grade bitumen	Wet Process	-
Bitumen + LDPE	Dry process	LDPE-3,6,9%
Bitumen + Crumb Rubber	Wet process	CRUMB RUBBER-8,10,12%

4.1 MINISTRY OF ROAD TRANSPORT AND HIGHWAYS SPECIFICATIONS FOR SDBC

Ministry of Road, Transport and Highways (MORT&H) has provided specifications for road and bridge works. The specifications for SDBC are as follows:

Table 2 Specifications for SDBC

S.R No.	Parameter	Specified Limits
1	Minimum stability (Kg at 60oC)	820
2	Minimum flow (mm)	2
3	Maximum flow (mm)	**4**

4	Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
5	Percent air voids	**3-5**
6	Per cent voids filled with bitumen (VFB)	**65-78**

4.2 RESULTS AND DISCUSSIONS

The SDBC was prepared by Marshall method using the 60/70 grade bitumen and the various mix design characteristics of the Marshal stability value, Flow value, Bulk Density , Air Voids (Vv) , Voids in mineral aggregate (VMA) , Voids filled with bitumen(VFB) were found out. The results are shown in table

Table 3: Marshall Test result

SR.NO	Bitumen %	Marshal stability (Kg)	Flow value (mm)	Bulk Density (gm/cc)	Air voids % Vv	VMA	VFB %
1	**4.50**	**845**	**2.86**	**2.234**	**4.93**	**14.97**	**67.23**
2	**4.75**	**865**	**3.10**	**2.236**	**4.44**	**15.05**	**70.12**
3	**5**	**945**	**3.26**	**2.245**	**3.64**	**14.85**	**74.55**
4	**5.25**	**880**	**3.71**	**2.235**	**3.24**	**14.98**	**77.76**
5	**5.50**	**850**	**3.98**	**2.23**	**3.04**	**15.29**	**77.96**

The outcomes demonstrate that with 5% bitumen content higher estimation of Marshall Stability esteem and more noteworthy thickness was accomplished. Every single other parameter were likewise well inside the particulars of MORT&H. Henceforth with 5% bitumen substance of 60/70 review bitumen changing rates of LDPE and Crumb Rubber was included and SDBC blend was readied. The consequences of SDBC blend with shifting level of LDPE are appeared in the accompanying table:

Table 4. Results of SDBC Mix for Varying Percentages of LDPE

SR.NO	LDPE%	Bitumen %	Marshal stability (Kg)	Flow value (mm)	Bulk Density (gm/cc)	Air voids % Vv	VMA	VFB %
1	**3**	**5**	**1150**	**3.10**	**2.255**	**4.96**	**14.92**	**67.21**
2	**6**	**5**	**1120**	**3.88**	**2.237**	**4.48**	**15.04**	**70.13**
3	**9**	**5**	**1185**	**3.91**	**2.244**	**3.62**	**14.89**	**74.57**

From the above outcomes it is seen that Marshall Stability Values and Bulk Density expanded with the rate increment in the modifier (LDPE). Thus by expansion of LDPE the quality normal for the blend was upgraded opposite when it was not blended with 60/70 review bitumen. Table 4 demonstrates the aftereffects of SDBC Mix for Varying Percentages of Crumb Rubber. The Crumb Rubber was added to 60/70 review bitumen in differing level of 8%, 10% and 12%. The SDBC blend was set up with 5 % bitumen and the fluctuating rates of Crumb Rubber. The bitumen when blended with Crumb Rubber is named as Crumb Rubber Modified Bitumen (CRMB).

Table 5. Results of SDBC Mix for Varying Percentages of Crumb Rubber

SR.NO	**CRMB %**	**Bitumen %**	**Marshal stability (Kg)**	**Flow value (mm)**	**Bulk Density (gm/cc)**	**Air voids % Vv**	**VMA**	**VFB %**
1	8	5	1065	3.10	2.255	4.96	14.92	77.21
2	10	5	1190	3.68	2.237	4.48	15.04	74.13
3	12	5	1180	3.71	2.244	3.62	14.89	74.57

From the above outcomes it is seen that the Marshal Stability Value are expanded from 8% to 10% Crumb Rubber and afterward it is diminished i.e 10% of Crumb Rubber of the heaviness of bitumen is the ideal portion for getting upgraded quality attributes of SDBC blend. The mass thickness additionally demonstrates expanding pattern from 8% to 12. The estimations of different parameters are additionally inside the required particular breaking points.

5. CONCLUSION

The examination on the utilization of LDPE and CRMB uncovers that the Marshal Stability esteem, or, in other words parameter of SDBC has indicated expanding pattern and the most extreme qualities have expanded by around 25 % by expansion of LDPE and CRMB. The thickness of the blend has likewise expanded in both the instances of LDPE and CRMB when contrasted and 60/70 review bitumen. This will give more steady and sturdy blend for the adaptable asphalts. The workableness and protection from dampness will likewise be better when contrasted with the regular strategy for development. The estimations of different parameters i.e. Vv, VMA and VFB in both the cases LDPE and CRMB have discovered to be inside required determinations. This examination not just helpfully uses the waste plastic and tires in street development industry yet it has additionally successfully upgraded the vital parameters which will at last have better and long living streets. Plastic streets would be a help for India's hot and to a great degree sticky atmosphere, where temperatures as often as possible cross 50°C and exuberant downpours make ruin, leaving a large portion of the streets with overwhelming troubles. This unfavorably influences the life of the asphalts. The polymer changed bitumen indicate better properties for street development and plastics squander which generally are viewed as a contamination hazard. It can discover its utilization in this procedure and this can help in taking care of the issue of contamination in light of the fact that the greater part of the plastic waste is polymers. In the adjusted procedure (dry process) plastics squander is covered over total. This has better authoritative of bitumen with the plastic-squander covered total because of expanded holding and expanded zone of contact among polymer and bitumen. The polymer covering additionally lessens the voids. This keeps the dampness ingestion and oxidation of bitumen by captured air. The street can withstand overwhelming movement and show better administration life. This examination will positively affect the earth as it will diminish the volume of plastic waste to be discarded by burning and land filling. It won't just increase the value of plastic waste however will build up an innovation, or, in other words.

REFERENCES

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

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

[3] Vasudevan, R., Utilization of waste plastics for flexible pavement, Indian High Ways Indian Road Congress, Vol. 34, No.7, 2006.

[4] Yadav Kajal, Sangita and Chandra A, Identification, Characterization and Quantification of Elastomeric/Plastomeric Waste for Sustainable Waste Minimization American Journal of Environmental Sciences 1(3) pp-202-205, 2005.

[5] T. Awwad Mohammad and Sheeb Lina The Use of Polyethylene in Hot Asphalt Mixtures, American Journal of Applied Sciences 4 (6) pp-390-396, 2007.

[6] 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.

AUTHORS

Tanuj Parmar
Assistant Professor
Civil Engineering Department
Dr. S & S S Ghandhy Government
Engineering College, Surat

Pinal Patel
BE Civil Engineering Student
Dr. S & S S Ghandhy Government
Engineering College, Surat

Tapan Patel
BE Civil Engineering Student
Dr. S & S S Ghandhy Government
Engineering College, Surat

Hemil Patel
BE Civil Engineering Student
Dr. S & S S Ghandhy Government
Engineering College, Surat

Smarika
BE Civil Engineering Student
Dr. S & S S Ghandhy Government
Engineering College, Surat