

UTILIZATION OF PLASTIC WASTES IN BITUMINOUS CONCRETE – A REVIEW STUDY

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Abstract : Generally bituminous blend are mostly used in pavements development. As we all know that plastic takes a very very prolonged time for its decomposition. It is tough and non-biodegradable, the compound bonds make plastic solid and impervious to a characteristic procedure of corruption for environment. Plastics are made of carbon and hydrogen known as hydrocarbons. A few properties of plastic incorporate their light weight, high protection from different synthetic compounds, recyclability, penetrability, protection from breakage, flexibility. Plastic is otherwise called polymers. Moreover, thinking about the natural methodology, the use of plastic is expanding in fantastic way. As we realize that plastic can't be disintegrated and this prompts various regular issues. Subsequently it must be used by reusing every one of these losses to lay streets. This waste joins plastic jugs; convey packs, cups and other utilized plastic bituminous folios are regularly utilized in clearing industry. The basic pieces of bituminous concrete (BC) are coarse total, fine total and bitumen.

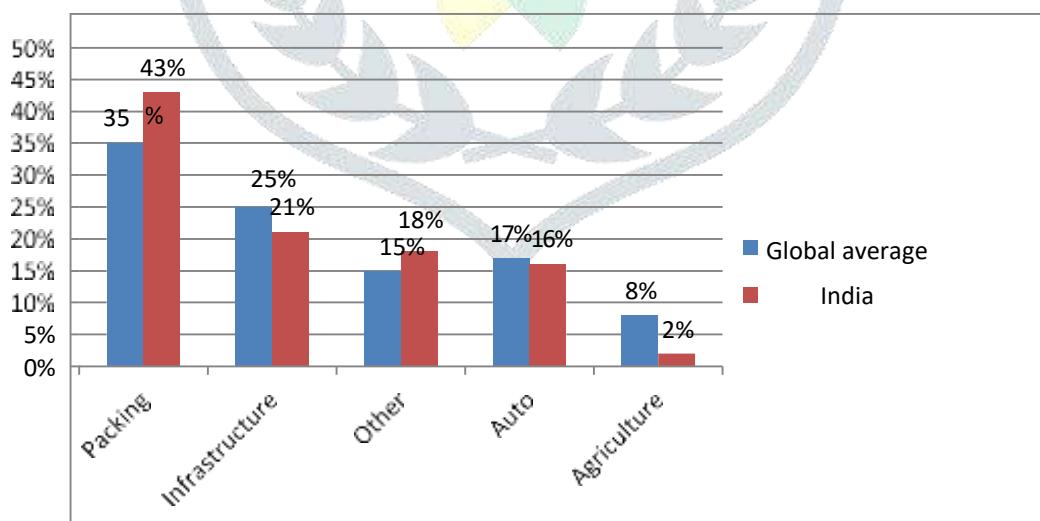
IndexTerms - RAP, BC, Bituminous mixer, Binder.

1. INTRODUCTION

1.1 Current consumption of plastic in India

India local assorted variety in utilization of plastic with western India representing 47%, Northern India representing 23% and Southern India representing 21% Polymer usage in different divisions:

Table 1.1 Current consumption of plastic in India



1.1.2 FLEXIBLE PAVEMENTS

Adaptable asphalts are those which incorporate a blend of black-top or bituminous material. The totals are situated on a bed of compacted granular material of appropriate quality inside the layer over the sub grade. Surface cracking and Rutting plays an important role in designing the flexible pavement. In this, the heap circulation depends absolutely on layer framework.

1.1.3 RIGID PAVEMENTS

Inflexible asphalts are built from bond concrete or strengthened cement, in this manner the asphalt structures don't twist or redirect because of the activity of overwhelming traffic wheel load. Rigid pavements transfers the load through slab action in bending. These sorts of asphalts has inflexibility and high modulus of flexibility to disperse the heap over a moderately wide territory of soil hence such asphalts are much unbending than the adaptable asphalts.

1.2 BITUMINOUS MIX DESIGN

1.2.1. OVERVIEW

The bituminous mix configuration is used to choose the %age of bitumen, coarse aggregates, fine aggregates and filler to create a blend that is intense, solid, useful and cheap. A precise structure can spare extensive expense of development just as the reliable execution of the roadway can be practiced.

1.2.2. BITUMINOUS MIX DESIGN

OBJECTIVE

- To build up a solid asphalt.
- To juxtapose shear disfigurement under traffic at a higher temperature.
- To avert shrinkage breaks at low temperature.
- Higher functionality to permit simple situation without separation.
- To go without splitting

1.2.3. REQUIREMENT OF BITUMINOUS MIX

The bituminous mix used for the development of pavements ought to have following properties:

- Stability
- Durability
- Flexibility
- Workability
- Skid resistance
- Other fascinating properties like stability to fulfill traffic demand, bitumen content to ensure correct binding, flexibility to fulfil traffic load etc.

1.2.4. TYPES OF MIX DESIGN WELL-GRADED MIX

This sort of blend fuses a reasonable extent everything being equal and are known as thick Bituminous Macadam, offer reasonable compressive quality and elasticity.

1. **Gap-graded mix:** In this sort of mix some huge size coarse totals are missing and has legitimate weakness and rigidity.
2. **Open-graded mix:** In this type of mix the fine totals and filler are deficient with regards to, it is permeable and gives right grating and low quality.
3. **Hot mix asphalt concrete:** This kind of blend was created by warming the black-top to bring down thickness and the totals are dried sooner than mixing to remove the dampness.

1.2.5. DIFFERENT LAYERS IN A PAVEMENT

The base course includes mineral totals, for instance, stone, shake, or sand interlocked along by a bituminous material and utilized as an establishment upon that cover or surface course is built up. In bituminous folio course, a bituminous-complete blend is utilized as a center course between the base and surface courses or in light of the fact that the principle bituminous layer in an exceedingly 2 layer bituminous reemerging. Bituminous cement contains a mix of total consistently reviewed from most noteworthy size, regularly underneath 25mm through fine filler that is under 0.75 mm. adequate measure of bitumen was added to the mix so as to make the compacted mix appropriate, impenetrable and dissipative.

1.3. POLYMER-MODIFIED BITUMINOUS CONCRETE

1.3.1 REASONS FOR USING WASTE PLASTIC IN ROAD CONSTRUCTION

- Increase sturdiness and consumption safe
- It has longer life and is efficient
- Maintenance free.
- Resistant to climatic conditions

1.3.2. WASTE PLASTIC IS A CONCERN

The plastic is non-degradable in nature, so as to lessen contamination we can utilize squander plastic in a bituminous blend. It helps decreasing the need of bitumen by around 10%, builds the quality and execution of street, brings down utilization of an enemy of stripping specialist and diminishes the transfer of plastic waste. This sort of innovation demonstrates to be most eco-accommodating in a portion of the tasks where waste plastic is blended with a bituminous blend. A portion of the activities are The Bruhat Bengaluru Mahanagare Palike has utilized plastic on about 600km of streets, the plastic fused street task had ideal outcomes on real streets in Bangalore including Shankar Mutt Road, KH Road, MG Road, JC Nagar Road, Rajarajeshwari Junction.

2. LITERATURE REVIEW

2.1. Studies on Use of waste polyethylene in paving mixes

Wegan and Nielsen (2001) examined microstructure of polymer altered fasteners in bituminous blends by getting ready slim areas of the example and breaking down that slender segment by Infrared Fourier Transform Spectrometer. At the point when meager segments were enlightened with the UV-light, the polymer stage radiates yellow light, fine and coarse totals frequently seem green, the bitumen stage is dark and air voids or breaks show up with a yellow-green shading.

Vasudevan (2004) utilized polythene/polypropylene Bags for facilitated headway of Rural and Arterial road arrange for budgetary Growth. He thought about both dry and wet mixing process by including polymer in regards to the heaviness of bitumen utilized. Creator nitty gritty that polymer bitumen blend is an unrivaled spread stood out from plain bitumen coming about higher Marshall Stability and reducing the possible results of potholes game plan.

Dr. R.Vasudevan and S. Rajasekaran, (2007) stated that the polymer bitumen blend is a better binder compared to plain bitumen. Blend has increased Softening point and decreased Penetration value with a suitable ductility.

Sundaram & Rojasay (2008) contemplated the Effective mixing procedure for the utilization of plastic waste into bitumen for street laying and Polymer-bitumen blends of various creations were arranged and utilized for doing different tests. This sort of innovation demonstrate to be most eco-accommodating in a portion of the ventures where waste plastic is blended with bituminous blend. A portion of the ventures are The Bruhat Bengaluru Mahanagare Palike has utilized plastic on about 600km of streets, the plastic model was effective on real streets in Bangalore including Shankar Mutt Road, KH Road, MG Road, JC Nagar Road, Rajarajeshwari Junction.

Yousefi (2009) expressed that the polyethylene particles don't will in general tear in bitumen medium and these particles want to consolidate and shape bigger particles because of interfacial and between molecule appealing powers and the main impediment in the adjustment procedure was the presence of allotments produced using liquid bitumen. As indicated by the writer at whatever point, particles had enough vitality to approach together and conquer the slight remained bitumen film which was isolating particles, the mixture of polyethylene particles happened and lead to polymer stage partition.

Herndon (2009) analyzed soddleness lack of protection of dark top mix using phosphonylated reused polythene. They showed that there is a basic abatement in moistness helplessness with the development of reused unmodified polyethylene to dark top strong mixes in both the Wet Process and the Dry Process.

Bindu and Beena (2010) examined how Waste plastic goes about as a balancing out added substance in Stone Mastic Asphalt when the blends were exposed to execution tests. Counting Marshall Stability, rigidity, compressive quality tests and Tri-pivotal Tests. There results demonstrated that adaptable asphalt with elite and Durability can be acquired with 10% destroyed plastic.

Firoozifar et al. (2010) researched the novel strategies to improve the capacity strength and low temperature helplessness of polythene altered bitumen. They utilized Kerosene, Oleic Acid, Aromatic oil, B-oil and so forth for expanding solidness of polythene altered bitumen and a fluorescent magnifying lens to watch the homogeneity of the examples.

Sui and Chen (2011) examined application and execution of polyethylene as adjusting added substance in black-top blend. They added polyethylene as added substance to hot mineral total for couple of minutes, and after that additional the black-top combining which improves the development procedure and lessens the expense of development. They inferred that there is enhancement for high temperature dependability, low temperature splitting opposition and water obstruction on change and assess polyethylene as added substance in the specialized, financial and ecological perspectives.

Sangita et al. (2011) proposed a novel way to deal with improve street quality by using plastic waste in street development. As indicated by them India spends Rs 35,000 crores every year on street development and fixes, including Rs 100,000 crores per year just on upkeep and streets by bitumen adjustment keeps going 2-3 times longer, which will spare us Rs 33,000 crores per year in fixes, in addition to diminished vehicle mileage.

Khan and Gundaliya (2012) communicated that the technique of progress of bitumen with waste polythene improves impenetrability to breaking, pothole advancement and rutting by extending mellowing point, hardness and reducing stripping in view of water, as such upgrading the general execution of lanes over a drawn out stretch of time. As shown by them the waste polythene utilized in the mix casings covering over sums of the mix which diminishes porosity, maintenance of soddleness and upgrades confining property.

Gawande et al. (2012) gave a review on waste plastic usage in asphalting street by utilizing both wet and dry strategy. They said that utilization of changed bitumen with the expansion of handled waste plastic of around 5-10% by weight of bitumen helps in improving the life span and asphalt execution with minimal sparing in bitumen use and as indicated by them utilization of waste plastics in the assembling of streets and covered material additionally help to devour huge amount of waste plastics. Subsequently, these procedures are socially exceptionally pertinent, giving better foundation.

Khan and Gundaliya (2012) expressed that the procedure of adjustment of bitumen with waste polythene upgrades protection from splitting, pothole arrangement and rutting by expanding relaxing point, hardness and lessening stripping because of water, along these lines improving the general execution of streets over a significant lot of time. As per them the waste polythene used in the blend structures covering over totals of the blend which lessens porosity, retention of dampness and improves restricting property.

Pareek et al. (2012) completed test ponder on customary bitumen and polymer altered cover and watched a noteworthy improvement in the event of rutting opposition, roundabout rigidity and versatile modulus of the bituminous solid blend with polymer changed bitumen. They likewise inferred that Polymer adjusted bitumen results a high versatile recuperation (79%) and better age opposition properties (The misfortune in weight on warming in slight film broiler is multiple times higher when contrasted with customary bitumen of 60/70).

Prusty (2012) examined the conduct of BC blends adjusted with waste polythene. He utilized different rates of polythene for arrangement of blends with a chose total reviewing as given in the IRC Code. Marshall Properties, for example, security, stream esteem, unit weight, air voids are utilized to decide ideal polythene content for the given evaluation of bitumen (80/100) in his examination. Considering these elements he saw that an increasingly steady and tough blend for the asphalts can be acquired by polymer alterations.

Swami et al. (2012) examined that the all out material expense of the undertaking is decreased by 7.99% with expansion of plastic to bitumen between the scopes of 5% to 10%. They presumed that by adjustment of bitumen the issues like seeping in hot temperature locales and sound contamination because of overwhelming traffic are decreased and it at last improves the quality and execution of street.

Moghaddam and Karim (2012) revealed that the usage of waste material in black-top asphalt would be valuable so as to locate an elective answer for increment administration life of black-top asphalt and diminish ecological contamination also. Structure their

investigation it is reasoned that Polyethylene Terephthalate (PET) strengthened blends have higher security esteem, stream, exhaustion life in correlation with the blends without PET.

3. CONCLUSION

In this study we talk about diminish the expense of asphalt development by including waste plastic in blend at some significant dimension. It will likewise help in decrease of contamination brought about by waste plastic somewhat. This sort of innovation decreases the maintenance cost of street as well as builds the life expectancy of the asphalt surface. This waste joins plastic jugs; convey packs, cups and other utilized plastic bituminous folios are regularly utilized in clearing industry. A pavement has unmistakable layers. The basic pieces of bituminous concrete (BC) are coarse total, fine total and bitumen.

4. REFERENCES

Afroz Sultana. S. K. , K. S. B. Prasad, July-August 2012, “Utilization of Waste Plastic as a Strength Modifier in Surface Course of Flexible and Rigid Pavements”, (International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue 4, pp.1185-1191)

AI-Hadidy A.I. and Yi-qiu T. (2009), Effect of Polyethylene on life of Flexible Pavement”, Journal of construction and Building materials, volume 23, pp 1456-1464

Amit Kumar Sahu and r.k Singh (2016) “Application of Waste Plastic Material in Road Construction” International Seminar on Utilization of Non-Conventional Energy Sources for Sustainable Development of Rural areas, ISNCESR’16

Dr. R. Vasudevan, S.K. Nigam, R. Velkennedy, A. Ramalinga Chandra Sekar, B. Sundarakannan “Utilization of Waste Polymers coated Aggregate for Flexible Pavement And easy Disposal of Waste Polymers” Proceedings of the International Conference on Sustainable Solid waste Management, Chennai, India. pp. 105-111, 5- 7September (2007)

D S V Prasad, M.Anjan Kumar, G V R Prasada Raju, V . Kondayya “A Study on Flexible Pavement Performance with Reinforced Fly ash Sub base” International Journal of Earth Sciences and Engineering 4ISSN 0974-5904, Volume 04, No 06 SPL, October, pp. 403-408(2011)

JDr. R. Vasudevam and S. Rajase Karan, (2007) “Utilization of Waste Plastic in Construction of Flexible bituminous road” (International Journal of Engineering Science and Technology, Vol. 4, pp. 2351-2355)

Henning, N. E. (1974). "Evaluation of lignite fly ash as mineral filler in asphaltic concrete." Report No. Item (2)-73, Twin City Testing and Engineering Laboratory, St. Paul, Minn.

Jianhong Dia, Zhanliang Liu, “Influence of Fly Ash Substitution for Mineral Powder on High Temperature Stability of Bituminous Mixture” International Conference on Future Energy, Environment, and Materials 2012.

J. Mater. “Coal Ash Utilization In Asphalt Concrete Mixtures” Civ.Eng.11, 295(1999) on”, Bureau of Indian Standard, New Delhi

Meor O. Hamzah , and Teoh C. Yi “ effects of Temperature on Resilient Modulus of Dense Asphalt Mixtures Incorporating Steel Slag Subjected to Short Term Oven Ageing” World Academy of Science, engineering and Technology 46 , 008

Moghaddam T. B. and Karim M. R. (2012), “Properties of SMA mixtures containing waste Polyethylene Terephthalate”, International Journal of Chemical and Biological Engineering 6, pp. 188-191.

Murphy M., O'Mahony M., Lycett C. and Jamieson I. (2001),“Recycled polymers for use as bitumen modifiers”, Journal of materials in civil engineering, Volume 13, pp. 306-314.

Pankaj P.Schedame, Nikhil H.Pitale “Experimental Study of Bituminous Concrete Contain Plastic

Waste Material" (e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 11, Issue 3 Ver. II (May- Jun. 2014), PP 37-45

Pareek A, Gupta T. and Sharma R.K (2012), "Performance of polymer modified bitumen for flexible pavements", International journal of structure and Civil engineering research, Vol.1, pp.1-10

Pankaj P.Shedame and Nikhil H.Pitale (2014) "Experimental study of Bituminous Concrete containg plastic waste material" (IOSR Journal of Mechanical and Civil Engineering, e-ISSN: 2278-1684, p-ISSN: 2320- 334X, Volume 11

Panda M. and Mazumdar M. (2002), "Utilization of reclaimed polyethylene in bituminous paving mixes", Material in Civil Engineering, Volume 14, Issue 6, pp. 527-53.

Robin L. Schroeder "The Use of Recycled Materials in Highway Construction" Autumn 1994 Vol. 58 • No. 2

