International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 5, July-August 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Evaluation of Different Paving Mixes Using Optimum Stabilizing Content

Naveen Kumar[1], Ms. Shivani[2]

[1]M Tech Scholar, [2]Assistant Professor,
[1,2]Sat Priya Group of Institutions, Rohtak, Haryana, India

ABSTRACT

Bituminous mixes are most commonly used all over the world in flexible pavement construction. It consists of asphalt or bitumen (used as a binder) and mineral aggregate which are mixed together, laid down in layers and then compacted. Under normal circumstances, conventional bituminous pavements if designed and executed properly perform quite satisfactorily but the performance of bituminous mixes is very poor under various situations. Today's asphaltic concrete pavements are expected to perform better as they are experiencing increased volume of traffic, increased loads and increased variations in daily or seasonal temperature over what has been experienced in the past. In addition, the performance of bituminous pavements is found to be very poor in moisture induced situations. Considering this a lot of work has been done on use of additives in bituminous mixtures and as well as on modification of bitumen. Research has indicated that the addition of polymers to asphalt binders helps to increase the interfacial cohesiveness of the bond between the aggregate and the binder which can enhance many properties of the asphalt pavements to help meet these increased demands. However, the additive that is to be used for modification of mix or binder should satisfy both the strength requirements as well as economical aspects.

KEYWORDS: *Bituminous Mix, Asphalt, Binder, Mineral Aggregate*

How to cite this paper: Naveen Kumar | Ms. Shivani "Evaluation of Different Paving Mixes Using Optimum Stabilizing Content" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-5, August 2021, pp.1337-1340, URL: www.ijtsrd.com/papers/ijtsrd45089.pdf

IJTSRD45089

GENERAL

The use of bituminous binders is very frequent for construction of pavement in day to day life. Generally, the pavements are majorly classified into two groups: namely flexible pavements and rigid pavements. The flexible pavements are the type of pavements which consists of having lower flexural strength but are highly flexible from structural point of view when subjected to heavier loads. The deformations occurred in the lower layers of these pavements gets directly reflected to its surface completely. Meanwhile, the rigid pavements are the type of pavements in which top most surface (also called as the surface course) is made up of PCC i.e. plain cement concrete. Moreover, the complete pavement as a whole structural component is not able to undergo bending or deflection when subjected to external traffic load.

PREREQUISITES OF BITUMINOUS DESIGN MIXES

The design mixes made up of bitumen, which is used for the pavement construction must have the following characteristics:

1. The bituminous design mix must be properly stable or firm in nature.
2. The mix should be imperishable or highly durable
3. The design mix must sufficiently be resilient or flexible.
4. It should be able to withstand the skid resistance
5. It should be sufficiently workable so that the there should not be obstructions for its placement.

VARIOUS LAYERS OF PAVEMENTS

The base-course of bituminous pavement consists of aggregates with gradations in the form of rock ballasts (stones), gravels and sand particles. These should be perfectly bounded with each other through the binding material and are primarily used as the foundations over which the surface course or binders are placed.

The binder course, consist of a mixture of bitumen and aggregate is used in the form of an intermediate course or layer. This layer lies in the middle of the surface course and base course. This layer might also be as the first layer of bitumen for the bituminous resurfacing of two layers.

The asphaltic concrete or bituminous concrete is the perfect aggregate mixture in which the grading of aggregate is such that the highest size of the aggregate should be 25 mm and minimum size in the form of filler should be 0.075 mm. The quantity of bitumen to be added should be such that the it should help to create a proper bond between the aggregates and the mix in compacted state should be non-porous, impermeable and elastically stable.

PREVIOUS RESEARCHES ON POLYETHYLENE

- The IPC, Institute for Interconnecting and Packaging Electronic Circuits published a testing manual in 1995 to determine the various characteristics of polyethylene. The elongation, strength in tension and Young's Modulus of organic free films with the use of ASTM D 618, ASTM D 882, ASTM D 1005 and ASTM D 2370.
- The Thermo-Gravity analysis (TGA) technique has been used to study the various properties of polymers [Sichina et al. (2001)]. As per the study, this technique determines the rate of change of quantity and mass of a specimen with respect to time or temperature in controlled conditions of atmosphere. It measures the oxidative and thermal stability of the individual materials and their corresponding compositions. It is highly beneficial for study and analysis of polymeric materials which includes the thermo-sets, thermo-plastics, fibres, composite films and coatings of paints and elastomers.

PREVIOUS RESEARCHES ON POLYETHYLENE

- **Bindu and Beena (2010)** conducted a study that deals with the use of waste plastic in the form of stabilizer additive in stone mastic asphalt designed mix. This designed mix was then subjected to undergo testing for tensile and compressive strength, tri-axial compression test, Marshall Stability tests. It was concluded that only 10% content of shredded plastic may results into higher durability of the mix along with the great performance.
- As per the study carried out by **Fernandes et al. (2008)** that includes the use of polymer based modified asphalt in the form of elastomeric compound namely "SBS (Styrene Butadiene Styrene)". It was later compared with the characteristics of Modified binder after addition of shale oil and aromatic oil which enhances the compatibility of the mix. The time bound properties of the mix the SBS PMBs were analyzed in a dynamic shear rheometer (DSR). It was concluded that the aromatic compounds and shale oils consists of similar impacts over the micro structure, stability and most importantly the visco-elastic nature of the polymer based modified asphalt.
- **Gawande et al. (2012)** analyzed the experimental approach towards the overlay of bituminous surface, placed on October, 1987 in Lwarence County, Kentucky. The laboratory experiment used the limestone, bottom ash and natural sand in the form of fine aggregates. The conclusion made by this study represents that around 50% higher bituminous content is necessary for the mixture due to its absorptive properties of bottom ash used as aggregates. However, the increase in the quantity of bituminous content would definitely rise to the overall unit price of the material. Moreover, if limestone and natural sand is used with the bottom ash seems to improvise the basic performance of the surface mixture along with its characteristics of skid resistance.
- A bi-annual demonstration project was started by **Prusty (2012)** in which around 50% of aggregates were replaced by their substitute as bottom ash in the flexible pavement. This project included the considerable experiments of expected experimental influences along with the performance of the pavements in laboratory and fields both. The field performance of the roadways had been monitored by using the remote sensing in terms of resistance to strains, temperature probes along with the on-site pavement analysis.
- In 2003, the damage induced by the moisture to the bituminous design mixes having bottom ash is thoroughly studied and analyzed. Total 8 bituminous design mixes were produced having a single kind of bitumen content, two types of aggregates, bottom ash from three different sources and lime as additive by the use of

principles mentioned in AASHTO T-283. The use of lime improves the damage induced by the moisture to the bituminous design mixes when measured by the TSR. The value of TSR must be above 80% for a good mix. Although, the use of lime and bottom could not change the indirect strength in tension, the mixes having stone chips produced the higher amount of indirect strength in tension when compared with that in dry condition **[Pareek et al. (2012)].**

- Another research study was conducted in which the type of aggregate had impacts to determine the nature of emulsion in terms of anionic or cationic. The rate of reaction of aggregates completely depends upon the proportion of negative charge and its random distribution. E.g. the aggregates constituted of higher silica content are found to be acidic in nature and has evenly distribution of negative charges on their surfaces. Even, these charges are proved to be responsible for the strong adhesive bonding between the cationic emulsions and aggregates **[Sabina et al. (2009)].**
- As per **Reinke and Glidden (2002),** the performance evaluation of hot mix asphalt having bottom ash as content was tested in the laboratory. The scope of this study was to promote the use of bottom ash in the form of aggregate in wearing course, base course and sub-base course. This study was inspired by three way objectives to evaluate the design mix stability which includes the determination mechanical properties of bituminous mix having bottom ash content, evaluation of stability of the mixes using Marshall Test Method and evaluation of engineering parameters of Marshall Cube in the form of appearance and texture. The major conclusions drawn from the study indicates that the specimen having bottom ash is of extremely superior quality in terms of strength, flow, hardness and stiffness. As a result, the higher strength will be imparted to the pavement and may able to resist the heavily loaded traffic. The major limitation for the use of bottom ash in the bituminous designed mixes is the increase in the content of air voids that may leads to the decrease in the density of the mixture.
- The investigation for the practicability to use the fly ash as the extender to asphalt is done by **Yousefi (2009).** It also included determining the impact of various parameters such as particles size, etc on process of replacement. It was concluded that it was highly reasonable to replace the volume asphalt having medium fly ash by 40% if used in dry climatic regions while 30% when used in the moist climatic regions.
- **Moghaddam and Karim (2012)** experimentally analyzed the results of bottom ash on physical characteristics of the bituminous pavement mix. It was also considered to analyze the impacts of use of bottom ash for the improvement of performance parameters of the pavement distress. Total four samples having variable content of bottom ash was considered. At various temperature conditions, the various properties like creep, fatigue, resilient modulus and permanent deformation are also considered. The performance of the mix was ascertained by the use of VESYS model. The conclusions represented in the favour of bottom ash to be used as a filler to improve the resistance to stripping and characteristics of resilient modulus. The bottom ash had no impact on rut depth and serviceability conditions but with rise of temperature, surface cracks to the pavements get increased.

CONCLUSION

The following conclusions are drawn from this study:

- The aromatic compounds and shale oils consist of similar impacts over the micro structure, stability and most importantly the visco-elastic nature of the polymer based modified asphalt.
- The bottom ash has no impact on rut depth and serviceability conditions but with rise of temperature, surface cracks to the pavements get increased.
- It has been highly reasonable to replace the volume asphalt having medium fly ash by 40% if used in dry climatic regions while 30% when used in the moist climatic regions.

REFERENCES

[1] Ahmadinia E., Zargar M., Karim M. R., Abdelaziz M. and Ahmadinia E. (2012), "Performance evaluation of utilization of waste Polyethylene Terephthalate (PET) in stone mastic asphalt", *Journal of Construction and Building Materials, Volume 36*, pp. 984–989.

[2] Airey G. D., Rahimzadeh B. and Collop A. C. (2004), "Linear rheological behaviour of bituminous paving materials", *Journal of materials in civil engineering, Volume 16*, pp. 212-220.

[3] Al-Hadidy A. I. and Yi-qiu T. (2009), "Effect of polyethylene on life of flexible pavements", *Journal of Construction and Building Materials*, volume 23, pp. 1456– 1464.

[4] Bindu C. S., Beena K. S. (2010), "Waste plastic as a stabilizing additive in SMA", *International Journal of Engineering and Technology,*

Volume 2, pp. 379-387.

[5] Casey D., McNally C., Gibney A. and Gilchrist M. D. (2008), "Development of a recycled polymer modified binder for use in stone mastic asphalt", *Journal of Resources, Conservation and Recycling, Volume 52,* pp. 1167–1174.

[6] A. and Farzaneh O. (2010), "Investigation of novel methods to improve the storage stability and low temperature susceptivity of polyethylene modified bitumens*", petroleum & Coal, Volume 52*, pp. 123-128.

[7] Gawande A., Zamare G., Renge V. C., Tayde S. And Bharsakale G. (2012), "An overview on waste plastic utilization in asphalting of roads", *Journal of Engineering Research and Studies Vol. III/ Issue II.*

[8] Karim R. ., Islam N., Sajjad M. and Habib A. "Polyethylene, a potential solution to strength loss of bituminous pavement under water", *International symposium on geo- disasters, infrastructure management and protection of world heritage sites,* pp. 204- 207.

[9] Khan I. and Gundaliya P. J. (2012), "Utilization of waste polyethylene materials in bituminous concrete mix for improved performance of flexible pavements", *Journal of applied research, volume 1, issue 12*, pp. 85-86.

[10] 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.

[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.

[12] Pareek A., Gupta T. and Sharma R. K. (2012), "Performance of polymer modified bitumen for flexible pavements", *International journal of structural and civil engineering research, Volume 1*, pp. 1-10.

[13] Punith V. S. and veeraragavan A. (2012), "Behavior of asphalt concrete mixtures with reclaimed polyethylene as additive", *Journal of materials in civil engineering*, *Volume 19*, pp. 500–507.

[14] Rahman W. M. N. W. A. and Wahab A. F. A. (2013), "Green pavement using recycled polyethylene terephthalate (pet) as partial fine aggregate replacement in modified asphalt", *Journal of Procedia Engineering, Volume 53*, pp. 124 – 128.

[15] Sangita, Reena G. and Verinder k. (2011), "A novel approach to improve road quality by utilizing plastic waste in road construction", *Journal of Environmental Research and Developmen, Volume 5*, pp. 1036- 1042.

[16] Sui Y. and Chen Z. (2011), "Application and performance of polyethylene modifying additive in asphalt mixture", *ICTE (International conference on transportation engg)*, pp. 1915-1919.

[17] Vargas M. A., Vargas M. A., Sanchez-Solis A. and Manero O. (2013), "Asphalt/polyethylene blends: Rheological properties, microstructure and viscosity modelling*", Journal of Construction and Building Materials, Volume 45*, pp. 243– 250.

[18] Wegan V., Nielsen C. B. (2001), "Microstructure of polymer modified binders in bituminous mixtures", pp. 1-19.