A REVIEW PAPER ON LOWERING PRODUCTION TEMPERATURE OF MASTIC ASPHALT

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ABSTRACT

In recent days when fuel prices exceed all-time records and exhaustion of greenhouse gases are limited for producers. Mastic asphalt wearing coarse has gained worldwide acceptance in road construction because it provides a deformation-resistant, durable surfacing material, suitable for heavily trafficked roads. But in India the use of Mastic Asphalt is limited due to its high cost of preparation, high production temperature and exhaustion of greenhouse gases and emissions. The present investigation is aimed to study the effect of warm mix additives for lowering the production temperature of Mastic Asphalt. Mastic asphalt samples were prepared with & without coarse aggregates to decide upon the optimum percentage upto which the addition can be done. Various design codes such as IS, IRC & MORTH were used for the design of mastic asphalt samples and hardness number test was performed to set the criteria for the acceptability of the addition percentage. Ingredients were selected as per specifications laid in Indian Standard codes. Use of warm mix additive may enhance the engineering properties of Mastic asphalt as well as brings down the cost of fuel consumption.

Keywords: Mastic asphalt, warm mix additive etc.

1.INTRODUCTION

India has the second largest road network across the world summed at 4.7 million km. This road network transports more than 60% of all goods in the country and 85% of India's total passenger traffic. During last few decades, growth of vehicles is more than growth of population. Roads are the pathways use through a country to facilitate the movement of persons and exchange of commodities. Roads are the chief modes for the advancement of community. Without roads, the interchange of advantages moral, intellectual and physical, which now take place between rural and urban population will not exist. The roads are like arteries of a living body and are equally necessary in quickening and communicating life to the paths they lead. Mastic asphalt being more flexible as compared to the other wearing courses can sustain large deflections without cracking and thus easily cater tremendously increasing traffic load. Mastic asphalt is laid on pavements for city streets which carry extremely heavy traffic, on critical locations such as roundabouts, intersections, bus stops, bridge decks etc. which is recognized for excellent service for many years. Mastic asphalt concrete is a mix of filler, bitumen, fine aggregates and coarse aggregates in suitable proportion so as to yield a void less mass which flows like fluid at high temperature, but on cooling down to normal temperature, it is in solid or semisolid state. Mastic asphalt is potentially advantageous paving material due to high stability, high durability, very low maintenance and good riding quality. Mastic asphalt has gained and would further gain wide acceptance in road construction technique.

2. MATERIALS TO BE USED IN PRESENT STUDY

Binder: The binder shall be industrial grade bitumen as per IS: 702-1988 of suitable consistency satisfying the physical properties given in MORTH

Fine aggregates: Fine aggregates shall consist of crushed hard rock or natural sand or a mixture of both passing 2.36mm sieve and retained on 0.075mm sieve.

Coarse aggregates: The coarse aggregates shall consist of hard, clean, durable, crushed rock free of disintegrated pieces and free from any deleterious material and should satisfy physical requirements.

Filler: The filler should be limestone powder passing 75 micron with calcium carbonate not less than 80%.

Advantages:

- In heavily stressed area like toll plaza, junctions.
- Multi-level above ground open parking.
- Underground parking.

- Road dressing in hole patching.
- Top and bottom layer of road pavement.
- Protective and top layer of pavement with water proofing function on bridge structure.

3. NEED OF THE STUDY

The wide variations in climate, different physical characteristics, and mountainous terrain have great influence in India's road construction operations. Mastic Asphalt was first laid in India in 1961. Because of its high cost factor, lack of knowledge, its use is still limited until today to special locations. Therefore, due to the use of various additives or fillers, it is necessary to study changes in the engineering properties of mastic asphalt.

4. PREVIOUS RESEARCH

Although a lot of works were conducted on lowering the production temperature of hot mix asphalts and warm mix asphalts is done but there is not any work in the literature about addition of warm mix additive in mastic asphalt for lowering its production temperature. Furthermore, the present study may reduce the production temperature of mastic asphalt, which is the main reason for its limited use, and may also enhance the engineering properties of mastic asphalt.

Shaleha I. Vahora et al, [2017]: WMA (Warm Mix Asphalt) is an innovative technology which is rapidly emerging in India which takes a prospective step towards conserving resources while addressing growing environmental sustainability. WMA technology allows the mixing, lay down, and compaction of asphalt mixes at significantly lower temperatures compared to Hot Mix Asphalt (HMA). The technology can reduce production temperatures by as much as 30 percent.

María del Carmen Rubio et al, [2013]: This paper presents the results of a research study whose main objective was to analyze the environmental benefits derived from a cleaner production technology for manufacturing asphalt mixes. The results obtained in this research project show that for the same manufacturing and spreading conditions, the half-warm mix asphalt (manufactured at less than 100°C) is a cleaner production technology and can be considered more environmentally friendly since it considerably reduced polluting emissions.

M. Carmen Rubio et al, [2012]: One of the causes of pollution associated with the construction of transportation infrastructures is the emission of greenhouse gases into the atmosphere. Even though the use of Warm Mix Asphalt technology has many advantages that are not related to the reduction of gas emissions, WMA technology is also good for the environment because it produces asphalt at temperatures 20-40 lower in comparison to Hot Mix Asphalt.

Zhanping You et al, [2011]: this research project evaluates the low-temperature performance of energy-efficient and environmentally friendly hot-mix asphalt (HMA) paving materials. Innovative materials gaining interest in the asphalt pavement industry includes warm mix asphalt (WMA), recycled asphalt shingle (RAS), reclaimed asphalt pavement (RAP), and bioasphalt. The materials are used as modifiers in typical HMA to enhance low-temperature field performances. Sasobit compounds at 0.5, 1.0, and 1.5%, by weight of performance grade (PG) 52-34 asphalt binder, are used to design the WMA.

Audrius Vaitkus et al, [2009]: warm mix asphalt allows the producers of asphalt pavement material to lower the temperatures at which the material is mixed and laid on the road. Warm mix asphalt solution allows reducing the working temperature of asphalt up to 30°C. In this article presented overview of different technologies of warm mix asphalt production, the merits and demerits of these technologies. After the laboratory research with different kind and amount of additives for temperature lowering and different kinds of asphalt the most suitable technologies were chosen for warm-mix asphalt.

Jean-Martin Croteau et al, [2008]: this paper reviews that the asphalt paving industry is constantly exploring technological improvements that will enhance the material's performance, increase construction efficiency, conserve resources, and advance environmental stewardship. Warm mix asphalt is produced at temperatures 20 to 40ºC lower than hot mix asphalt (HMA).

Joel R.M. Oliveira (2012) et al; The objective of this paper is to assess the efficiency of using a surfactant based additive in the production of warm mix asphalts, by lowering the mixing temperatures of asphalt rubber and asphalt concrete mixtures without changing their performance. Several laboratory tests were carried out on asphalt rubber and asphalt concrete mixtures, with and without the additive, in order to evaluate and compare the performance of the mixtures. It was concluded that the incorporation of small amounts of a surfactant based additive allowed reducing the production temperatures of both types of mixture by 30℃ without compromising their performance, and this can be seen as a great step forward towards the production of cleaner asphalt rubber mixtures.

6. RESEARCH METHODOLOGY

The following steps are involved to conduct this study:

1. Suitable materials shall be selected according to guidelines of Indian standards and Indian Road Congress codes for design of mastic asphalt.
2. A control mix shall be prepared to determine the percentage of bitumen and lime and other ingredients.
3. Test specimens shall be prepared by adding different percentages of additives viz 0.5, 1.0, 1.5, 2% of bitumen.
4. Mastic asphalt samples shall be prepared with and without coarse aggregates at each of the percentage.
5. Hardness number test shall be performed.
6. Production temperature shall be measured and comparison shall be made to determine the worthiness of using additives.

7. CONCLUSION

1. After going through number of literature, it is observed that Mastic is gaining worldwide acceptance due to its good performance as wearing course at heavy duty pavements but the cost of mastic asphalt pavement is very high as compared to other wearing courses and it is one of the reasons for its limited use.

2. Expenses of this construction can be reduced by use of mineral fillers or additives which are usually by-products wastes have benefited in reducing the environment problems and also improving some properties of pavement.

3. Since the production temperature of mastic asphalt is very high. Therefore warm mixed asphalts are used in place of hot mix asphalts for lowering temperature by adding various additives, Sasobit compounds, surfactant-based additives etc.

4. Benefits of using Warm Mix Additives
   Environmental benefits: Lower plant emissions and fumes, improvement of working conditions in the asphalt laying process, decrease of smoke emission.
   Economic benefits: Energy consumption reduced and hence financial cost also reduced
   Paving benefits: Improved workability and compaction efficiency and quicker turnover to traffic due to shorter cooling time

5. It was observed from the above studies that the extent by which production temperature that can be reduced by using additives is about 20-30°C.

6. Most of the studies are confined to use of various fillers to enhance the properties of mastic asphalt but no work has been done in the field of addition of warm mix additive in the mastic asphalt.

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