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Performance Study of Hot & Cold Mix Using Bitumen and Emulsion

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Abstract: This project work describes laboratory experiments and presents results for the cold-mix mixtures. Construction of highway involves huge performances of hot and cold-mix mix outlay of investment. A precise design may save considerable amount of investment, as well, a reliable performance of the in-service highway can be achieved. Two things are of major considerations in this regard - pavement design and the mix design. This project work emphasizes some of the new considerations involved in the concept of mix design. Though there are a few equipment used for estimation of stability of the bituminous mixes in the laboratory. the Marshall test is the most popular one, possibly due to its simplicity and low cost.

1. INTRODUCTION

In this presentation, we will be discussing a performance study on hot and cold mix technology using bitumen and emulsion.

Hot and cold mix is an easy and cost-effective way to build roads.

Bitumen and emulsion are common materials used in this technology.

The study tested the materials for the unit weight of mix sample, stripping value, stability, optimum bitumen and emulsion content for the Marshall mix samples.

The goal is to find out which material works best to improve road quality

Objectives-

1. The purpose of the performance study of hot and cold mix using bitumen and emulsion is to evaluate the effectiveness of both types of asphalt in road construction.
2. The study aims to compare the advantages and disadvantages of hot and cold mix technologies using bitumen and emulsion in terms of durability, cost-effectiveness, and environmental impact.
3. The study will involve laboratory testing of both materials and field tests on actual roads to determine their performance.

2. Literature Survey

The history of hot and cold mix technology dates back to the early 1900s, where hot mix asphalt (HMA) was commonly used for road construction. However, the process of heating the asphalt to high temperatures was energy-intensive and led to environmental concerns.

In the 1970s, cold mix asphalt (CMA) was developed as a more environmentally friendly alternative to HMA. CMA uses emulsified or foamed asphalt that does not require heating and can be used at lower temperatures. However, CMA had lower durability compared to HMA and was mainly used for temporary repairs and low-traffic roads.

In recent years, advancements in technology have led to the development of warm mix asphalt (WMA), which uses additives to reduce the mixing and compaction temperature of HMA, making it more energy-efficient and environmentally friendly. Additionally, emulsified asphalt has been used in HMA to reduce the mixing temperature and improve workability.

3. Study of Materials

Studies on the use of bitumen and emulsion in hot and cold mix technology

3.1

Previous studies have shown that the use of bitumen and emulsion in hot and cold mix technology can improve the performance of asphalt pavements. For example, a study by Kavussi and Mirabdolazimi (2019) found that the addition of bitumen emulsion to cold-mix asphalt led to better workability, improved compaction, and increased durability

Another study by Zargar et al. (2017) investigated the use of emulsion in hot mix asphalt and found that it improved the mechanical properties of the mix, including its stiffness, fatigue resistance, and rutting resistance. Similarly, a study by Zhang et al. (2016) found that the addition of emulsified asphalt to hot mix asphalt resulted in better performance in terms of cracking resistance and moisture damage

Overall, these studies suggest that the use of bitumen and emulsion in hot and cold mix technology can lead to improved pavement performance, and further research is needed to optimize their use and understand the underlying mechanisms

3..1 Properties and characteristics of bitumen and emulsion:

Bitumen is a black viscous material that is a by-product of crude oil refining. It is used as a binder in asphalt to hold the aggregates together. Bitumen has several desirable properties, including high viscosity, adhesion to aggregates, and resistance to deformation and weathering. However, it is also susceptible to aging and cracking over time.

Emulsion is a mixture of water and bitumen, stabilized with an emulsifying agent. Emulsified asphalt has several advantages over traditional hot asphalt, including reduced energy consumption and lower greenhouse gas emissions. It can also be used at lower temperatures, which reduces the risk of worker injury during application. However, emulsified asphalt has lower durability and may require more frequent maintenance compared to hot asphalt

4 FLEXIBLE PAVEMENT-

4.1 Introduction to Flexible Pavement

Flexible pavement is a type of road pavement that is constructed using a combination of different layers of materials, including bitumen, aggregates, and other additives. It is called "flexible" because it can adapt to the underlying soil movement and traffic loads without cracking or breaking.

Flexible pavements are widely used in many countries, including India, due to their cost-effectiveness, ease of construction, and ability to handle heavy traffic loads. They are particularly suitable for areas with high rainfall or frequent freeze-thaw cycles, where rigid pavements can crack and fail.

Figure 4.1 Flexible Pavement

5. Present Investigation

Test results on Properties of aggregates, bitumen VG-30 and bitumen emulsion are shown in the following tables below.

5.1.1 PROPERTIES OF AGGREGATES

Table 5.1.1 Water absorption test

Sr No	Determination Number	I	II	III
1	Wt Of Saturated Surface Dried sample in gram (W1)	1001	1010	990
2	Wt Of Oven Dried Sample in Gram (W2)	996	1004	982
3	Water Absorption W1-W2/W2 *100	0.5	0.6	0.81
Average Value			0.63%	

- Average Value of Water Absorption Test = **0.63%**
- Maximum Required Value As Per IRC Recommendation is **2%**

Table 5.1.2 Specific Gravity test

Sr	Determination No	I	II	III
1	Wt Of Empty Pycnometer	578	578	578
2	Wt Of Pycnometer + Aggregate in grams (W2)	1066	1044	1084
3	Wt Of Pycnometer +Aggregate +Water	1900	1892	1932
4	Wt Of Pycnometer + Water in Grams (W4)	1596	1596	1596
5	Specific Gravity (G)	2.66	2.74	2.97
Average Value		2.79		

- Average Value of Specific Gravity test = 2.79
- Maximum Required Value as Per IRC Recommendation is 3

Table 5.1.3 Aggregate impact test

Sr no.	Determination No	I	II	III
1	Weight Of Aggregate Sample	330	330	330
2	Weight Of Aggregate Passing Through 2.36mm Sieve	31	40	33
3	Aggregate Impact Value	9.3	12.12	10
Average Value		10.48%		

- Average Value of Aggregate Impact test = 10.48%
- Maximum Required Value as Per IRC Recommendation is 27%

Table 5.1.4 Los Angeles abrasion test

Sr No	Determination No	I	II	III
1	Weight Of Aggregate Sample Taken Using Grade C	5000	5000	5000
2	Weight Of Sample After Abrasion Test Passing Through 1.7mm Sieve	680	650	690
3	Los Angeles Abrasion Test Value	13.6	13	13.8
Average Value		13.46%		

- Average Value of Abrasion test = 13.46%
- Maximum Required Value as Per IRC Recommendation is 35%

Table 5.2.5 Soundness test

Sr No	Test	Result
1	Elongation Index	28%
2	Flakiness Index	29%
Combined Elongation and Flakiness Index Value		28.50%

- The Combined Value of Elongation and Flakiness Index = 28.50%
- Maximum Required Value as Per IRC Recommendation is 35%

5.4 Comparison between Hot Mix and Cold Mix

Fig: 5.4.1 Comparison of Stability between Hot Mix and Cold Mix

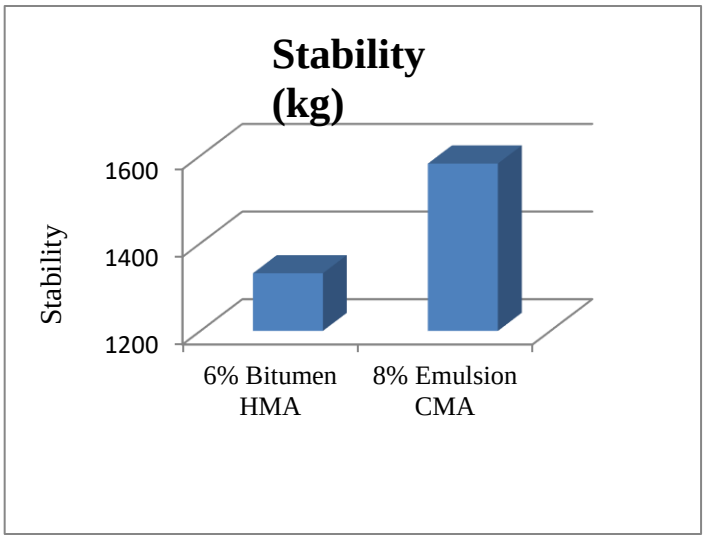
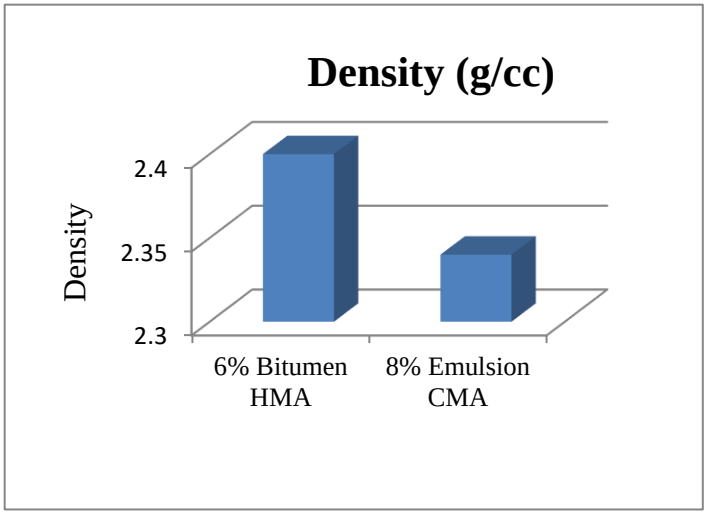


Fig: 5.4.2 Comparison of Density between Hot Mix and Cold Mix



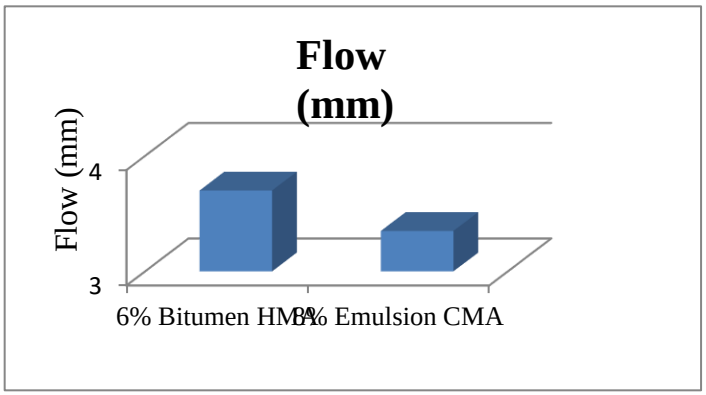


Fig: 5.4.3 Comparison of Flow between Hot Mix and Cold Mix

6. Results and Discussions

- Stability of cold mix asphalt is found greater than the Stability of hot mix asphalt as Shown in Fig: 5.4.2
- Density cold mix asphalt is less than the Density hot mix asphalt as Shown in Fig: 5.4.2.
- The Flow value of hot mix asphalt is more than the Flow value of cold mix asphalt as Shown in Fig: 5.4.3.
- The optimum emulsion content for cold mix asphalt is 8%
- The optimum Bitumen content for hot mix asphalt is 6%

Conclusions

The study was conducted on the performance study of hot mix asphalt and cold mix asphalt. Various tests were conducted and conclusions are drawn out.

Following are the conclusions drawn from the experimental study.

1. Physical properties of aggregate used in this experimental study were within the specifications.

2. Physical properties of Bitumen (VG-30) used in this experimental study were within the specifications.

3. Physical properties of Bitumen Emulsion used in this experimental study were within the specifications.

4. Results of Marshall Stability of cold mix asphalt were found 15.6% greater than the hot mix asphalt

5. Flow value of cold mix asphalt was found 9.46% less than the hot mix asphalt. Whereas the Flow value of cold mix asphalt was found within the specified range.

6. Density of cold mix asphalt was found 2.5% less than the hot mix asphalt.

7. From the results, it can be concluded that cold mix results are comparable with hot mix asphalt. Cold mix asphalt is found feasible for bituminous concrete layer.

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