ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Comparison of Cold Mix and Hot Mix Asphalt

[1]Mr Sangmesh R Ghale, [2]Mrs Smita V Pataskar

[1]Department of Civil Engineering, [2]Head of Department of Civil Engineering

[1] [2]D.Y.Patil College of Engineering, Akurdi, Pune. Savitribai Phule Pune University,Pune, India. Email: [1]sangmeshghale@gmail.com, [2]svpataskar@gmail.com

Abstract :- **Asphalt is an excellent binding material which is accepted by everyone in road construction industry. Although this material is long lasting and economical; it has a very important role in road construction. Aggregate and Asphalt mix gives an excellent design aspect which is strength to the constructed road. The mix is classified into two different categories, one is Hot Mix Asphalt and the other is Cold Mix Asphalt. Cold Mix Asphalt as it is considered as most economical as other mixes; this project gives a detail comparison between Hot Mix Asphalt and Cold Mix Asphalt. In India the rate of construction of road is increasing tremendously with growing economy and the demand from population. Multi crore projects are been sanctioned for road construction in urban and rural areas. But because of various number of flaws , bad practices and unacceptable perpetual habits of the working men the constructed roads are in a no use situation because endless number of potholes in it and these hoes are not only common on rural roads but are also frequently observed on urban roads were we have strong administration. So in this case Cold Mix Asphalt could be used on a large scale to reduce the number of potholes. This will become a very essential part in reducing accidents and traffic pollution and ultimately developing the country. So at this crucial stage the need and importance of Cold Mix Asphalt has risen and with use of Hot Mix Asphalt causing a negative impact on climate change, therefore promoting and putting Cold Mix Asphalt into actual use is our main concern.**

Keywords: **- Aggregate, Asphalt, Cold mix, hot mi, pot holes.**

I. INTRODUCTION

In this chapter, extensive literature survey on the various laboratory studies conducted for cold mix asphalt has been discussed. While going through the literature review, few works were observed in this field in comparison to hot mix asphalt.

1.1 Use of Asphalt emulsion in hot mix asphalt

Hot mix recycling is one of the popular pavement rehabilitation techniques. In central plant hot mix recycling, Reclaimed Asphalt Pavement (RAP) intended for recycling is combined with required quantity of virgin asphalt binder and new aggregates in a hot mix plant, located away from the construction site. The resultant mix is transported to the paving site, placed, and compacted to the required compaction level. Amongst various pavement recycling methods, hot mix recycling has certain advantages, such as, comparable performance to that of conventional mixes and better quality control. This is due to the fact that constituents are mixed under controlled conditions and it is possible to monitor mixing process continuously. In this process, less workspace is required for laying the recycled mix. Hence, this is suitable for the roads where the right-of-way is restricted.

Large number of studies has been reported on laboratory performance, field performance and pavement design with virgin asphalt mix (i.e., mix containing virgin binder and new aggregates). However, published studies on engineering characterization and pavement design with hot recycled asphalt mix are rather scanty. Some studies indicate that the amount of RAP used in the recycled mix affects the property of the mix, whereas, other study indicates that mix property is not significantly affected by the quantity of RAP used. Some researchers have found the stiffness modulus of recycled mix to be better than virgin mix, whereas other researchers have found similar or lower stiffness. Similarly, the indirect tensile strength of recycled mix is found to be satisfactory or better, or even poorer than its corresponding virgin mix. In general, recycled mix has a greater resistance to rutting than virgin mix. From field studies, rutting performance of recycled mix has been found better than virgin mix . However, in some studies it has been found the initial rutting rate is higher in recycled mix and in other studies it is observed that there is no significant difference between the rutting behavior of recycled and virgin mix.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

1.2 Use of Asphalt emulsion in cold mix asphalt

Transportation research circular entitled Asphalt Emulsion Technology has provided detailed information regarding Asphalt emulsion. An emulsion is a dispersion of small droplets of one liquid in another liquid. Emulsions can be formed by any two immiscible liquids but in most emulsions one of the phases is water. Asphalt emulsion is a liquid product in which a substantial amount of Asphalt is suspended in a finely divided form in water in presence of emulsifiers. The Asphalt droplets range from 0.1 to 20 micron in diameter.

II. COLLECTION OF RAW MATERIALS

Aggregate

We collected the aggregate from Hot Mix Plant, Ajwani Infra.Pvt.Ltd,Ravet, as per requirement for dense graded bituminous mixture as per grading of aggregates as per MORTH coarse aggregate consist of stone chips up to 4.75 mm IS sieve collected from a local source.

Fine aggregate comprises of stone dust with fraction passing 4.75 mm and retained on 0.075mm IS sieve.

Stone dust less than 0.075mm IS sieve.

Asphalt

Asphalt is also collected from Hot Mix Plant, Ajwani Infra.Pvt.Ltd, Ravet, of grade VG 30.

III. TEST ON MATERIALS

Aggregate

Following are the test performed on aggregates.

Table 1: Test Results on aggregate

Sr No	Type of test	Value
1	Aggregate Impact Test	7.68%
2	Aggregate Crushing Value Test	20.45%
3	Shape Test	12.74%
4	Specific gravity and water absorption Test	2.8 &1.26%
5	Los angeles abrasion test	15.22%

Asphalt

Following are the test performed on Asphalt.

Table 2: Test Results on Asphalt

Sr No	Type of test	Value
1	Penetration Value Test	10.233 mm
2	Ductility Test	65.5 cm
3	Specific gravity	1.028
4	Softening Point Test	48.25^0C
5	Flash and Fire point Test	235^0C & 279^0C

IV. TEST ON MIX (HOT MIX)

Marshall Stability Test

Theory: In this method, the resistance to plastic deformation of cylindrical specimen of bituminous mixture is measured when the same is loaded at the periphery of 5 cm per minute. The test procedure is extensively used in routine test. There are two major features of the Marshall method of designing mixes namely; (i) Density- voids analysis (ii) Stability flow tests. The flow value is the deformation the Marshall Test specimen undergoes during the loading, upto the maximum load, in 0.25 mm units. In this test an attempt is made to obtain optimum binder content for the type of aggregate mix and traffic intensity.

Apparatus: (a) Mould Assembly: Cylindrical moulds of 10 cm diameter and 7.5 cm height are required. It further consists of a base plate and coller extension. They are designed to be interchangeable with either end of the cylindrical mould. (b) Sample Extractor: For extruding the compacted specimen from the mould, an extractor suitably fitted with a jack or compression machine. (c) Compaction Pedestal and Hammer: It consists of a wooden block capped with M.S. plate to hold the mould assembly in position during compaction. The compaction hammer consists of a flat circular tamping face 8.8 cm diameter and equipped with a 4.5 kg weight constructed to provide a free fall of 45.7 cm. (d) Braking Head: It consists of upper and lower cylindrical segments or test heads having an inside radius of curvature of 5 cm. The lower segment is mounted on a base having two vertical guide rods which facilitate insertion in the holes of upper test head. (e) Loading Machine: The loading machine is provided with a gear system to lift the base in the upward direction. On the upper end of the machine, a precalibrated proving ring of 5 tonnes capacity is fixed. In between the base and the providing ring, the

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

specimen contained in the test head is placed. The loading machine produces a movement at the rate of 5 cm per minute. (f) Flow meter: One dial gauge fixed to the guide rods of a testing machine can serve the purpose. Least count of 0.025 mm is adequate. The flow value refers to the total vertical upward movement from the initial position at zero load to a value at maximum load. Besides the above equipment, the following are also required: (i) Ovens on hot plates, (ii) Mixing apparatus (iii) Water Bath (iv) Thermometers of range upto 200 degrees with sensitivity of 2.5 degrees.

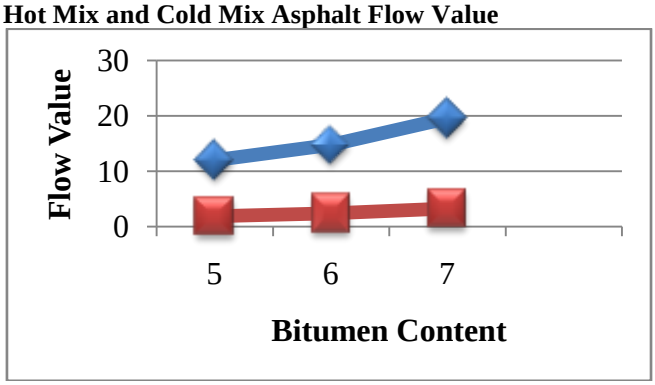
Figure 6.1.1 Marshall Stability apparatus

Observation and calculation

Table 3: Hot mix & Cold mix Asphalt values

	Hot mix Asphalt values			Cold mix Asphalt values		
Mass of aggregate in the mixing pan (gm)	1200	1200	1200	1200	1200	1200
Mass of Asphalt added (gm)	60	72	84	60	72	84
Asphalt content	5%	6%	7%	5%	6%	7%
Compacting temperature	28	28	28	28	28	28
Number of blow with hammer per face	50	50	50	50	50	50
DESCRIPTION						
Bulk specific gravity	2.26	2.29	2.18	2.13	2.17	2.25
Theoretical specific gravity	2.46	2.46	2.46	2.46	2.46	2.46
Volume of Asphalt (Vb)	11.08	13.24	14.96	10.44	12.92	6.51
Percentage air void (Va)	8.13	6.91	11.38	13.41	11.28	8.32
Void in mineral agg. (Va+Vb)	19.21	20.15	26.34	23.85	24.7	14.83
Void filled in Asphalt=100(Vb/Vma)	59.24	63.80	56.79	43.77	52.30	43.90
Measured stability (Kg)	812.7	767.3	662.8	7.03	6.78	5.88
Flow value(mm)	12	14.8	19.6	2.30	2.65	3.3

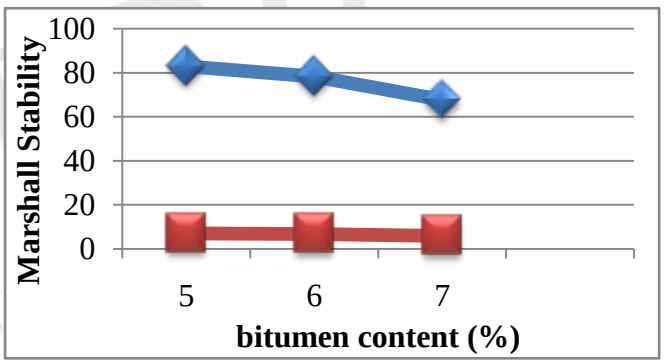
Hot Mix and Cold Mix Asphalt Flow Value



Graph of Comparison Hot Mix and Cold Mix Asphalt Flow Value

Interpretation: As compare to the Hot mix the Flow value increases in Cold Mix with increase in bitumen content.

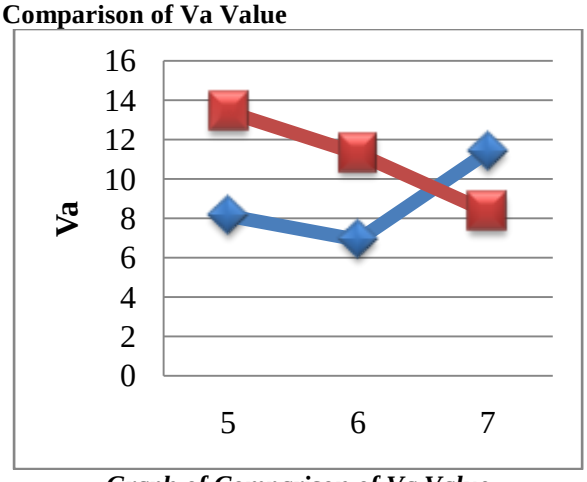
Comparison of Marshal Stability Value



Graph of Comparison of marshal stability value

Interpretation: Marshal Stability value of cold mix is greater than the hot mix asphalt.

Comparison of Va Value



Graph of Comparison of Va Value

ISSN (Online) 2456-1290

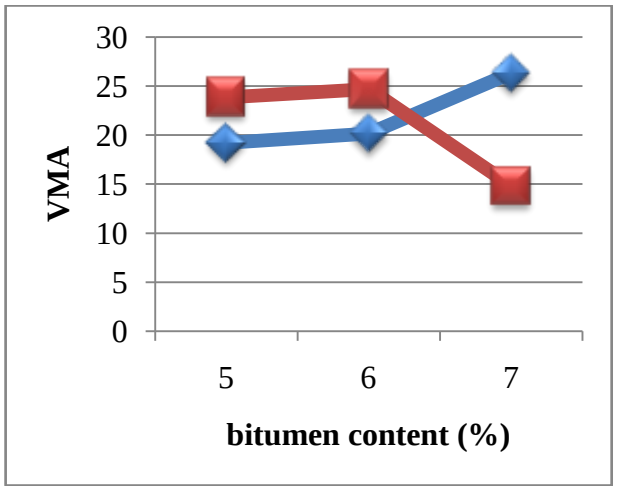
International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Interpretation: Va values of Cold mix and hot mix asphalt varies with vary in bitumen content.

Comparison of VMA Value



Graph of comparison of VMA value

Interpretation: VMA value of Cold Mix asphalt is greater than the hot mix at 7% bitumen content.

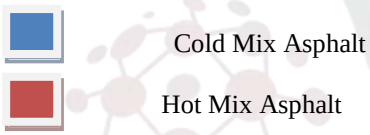


Table 4: Tentative Rate analysis of Hot Mix & Cold Mix Asphalt

RATE ANALYSIS (HOT MIX ASPHALT)	RATE ANALYSIS (COLD MIX ASPHALT)
• Length of road = 100m • Thickness of road = 0.43m **AGGREGATE** • Aggregate thickness = 100×7×0.2 = 140 cub mtr. • 1 Brass = 2.83 cub mtr = Rs. 3400/- • Rate of aggregate = Rs. 1,68,197/- **MIX** • Mix Thickness = 0.18 mtr. • Quantity required = 5100 cub mtr • Rate of Mix = Rs. 2,27,067/- **ASPHALT** • 1 Drum = 200 lit = Rs. 9500/- • Weight of Asphalt = 14×2300×0.06 = 1932 Kg • Rate of Asphalt = Rs. 91770/- **SEAL COAT** • Rate of 1 Brass Seal Coat = Rs. 4200/- • Total quantity of seal coat = 21 cub mtr. • Total rate of seal coat = Rs. 31,166/- **TOTAL RATE = Rs. 5,18,200/-**	• Length of road = 100m • Thickness of road = 0.43m **AGGREGATE** • Aggregate thickness = 100×7×0.2 = 140 cub mtr. • 1 Brass = 2.83 cub mtr = Rs. 3400/- • Rate of aggregate = Rs. 1,68,197/- **MIX** • Mix Thickness = 0.18 mtr. • Quantity required = 3900 cub mtr • Rate of Mix = Rs. 1,73,639/- **ASPHALT** • 1 Drum = 200 lit = Rs. 9500/- • Weight of Asphalt = 14×2300×0.06 = 1932 Kg • Rate of Asphalt = Rs. 91770/- **SEAL COAT** • Rate of 1 Brass Seal Coat = Rs. 4200/- • Total quantity of seal coat = 21 cub mtr. • Total rate of seal coat = Rs. 31,166/- **TOTAL RATE = Rs. 4,64,772/-**

V. RESULT AND CONCLUSION

According to all the tests carried out on both the mixes i.e. cold mix and hot mix Asphalt we conclude that cold mix Asphalt is more economical than hot mix but cold mix fails in providing the required strength and stability to the existing traffic density. Hence we conclude that cold mix can be used effectively and efficiently for rural road construction were traffic density is less and can be used on a large scale without harming the environment. Hot Mix Asphalt can be used for high density traffic conditions. To make this project up to the mark we calculated the overall cost for both Hot Mix Asphalt and Cold Mix Asphalt , this analysis concluded that the rate for 100 mtr. span of road is Rs.4,64,772/- and Rs.5,18,200/- for Cold Mix Asphalt and Hot Mix Asphalt respectively.

REFERENCES

[1] Asphalt Recycling and Reclaiming Association, Federal Highway Administration, US Department of Transportation, Basic Asphalt Recycling Manual. United States, 200.

[2] He Guiping et al, Laboratory Study on permanent deformation of foamed asphalt mix incorporating reclaimed Asphalt pavement materials Construction and Building Materials 21 (2007) 1809 1819.

[3] IswandaruWidyatmoko, Mechanistic-Empirical Mixture design for hot mix asphalt pavement recycling. Construction and Building Materials 22 (2008) 7787

[4] .Niazi et al, Effect of Portland cement and lime additives on properties of cold in -place recycled mixtures with asphalt emulsion Construction and Building Materials 23 (2009) 1338 1343

[5] Hamad I. Al-Abdul Wahhab et al, Study of road bases construction in Saudi Arabia using foam asphalt Construction and Building Materials xxx (2011) xxxxxx (Article in press).

[6] Pengcheng Fu et al, The effects of asphalt binder and granular material characteristics on foamed as phalt mix strength Construction and Building Materials 25 (2011) 10931101

[7] Mahmoud Ameri et al, Laboratory studies to investigate the properties of CIR mixes contain-ing steel slag as a substitute for virgin aggregates Construction and Building Material s 26 (2012) 475480