

Comparison Between Hot Mix and Cold Mix Bitumen

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ABSTRACT

Due to topographical constraints, rural roads projects in North Eastern States of India like Arunachal Pradesh, Assam, Manipur, Meghalaya and others are beyond time. Indian government is undergoing a massive rural road development plan and is highly concerned for the rural road development projects in North East states. Since many of the rural roads of North Eastern States are in hilly regions having heavy rainfall and many a times they have to meet very strict environmental regulations as many of these projects also lies in forest zone. It sometimes becomes very difficult to go with HMA only for rural road construction. Use of cold mixes should be evaluated in these states. Cold mix asphalt consists of unheated aggregate with emulsion or cutback as binder. Cold mix also offers advantages like; reduction in emissions, low fuel consumption, can be used in rainy seasons etc. This paper presents the mix design of cold mixes for use in different courses of pavements. The paper provides information on the different additives which are usually used to increase the performance of cold mix. It also gives the results of same earlier studies on cold mixes. It also highlights the scope of using cold mix in rural road construction in North Eastern states of India.

Keywords: Additives in cold mix, cold mix, design of cold mix and emulsified mix.

ARTICLE INFO

Article History

Received: 25th May 2016

Received in revised form :
26th May 2016

Accepted: 28th May 2016

Published online :

30th May 2016

I. INTRODUCTION

Several ambitious road construction plans and activities primarily involve bituminous pavements with hot mix technology. Hot mix technology which is a very conventional method for road construction, has structurally satisfied the performance requirements over many years. The procedures generally followed by the hot mix technology are heating of binder and aggregate, mixing, tack coating, laying of mix followed by the compaction process everything done at high temperature in a range of 120C to 165C temperature. Though performance wise this has been the most suitable for pavement structures, but their high use have several drawbacks like environmental degradation, high energy consumption, increase in carbon footprint, low output for mix production, low laying work in rains and cold weather, limited construction period in a year, oxidative hardening of binder, health and safety hazard to labour . Besides this, in some North and North Eastern parts of India like Jammu and Kashmir, Assam, Manipur, Meghalaya, Arunachal Pradesh and others, rural road projects involving several lakhs and

crores of rupees are beyond time. Due to topographical and weather constraints, it is difficult to work with hot mix technology in such hilly regions, heavy rainfall and forest zones. So, it is desirable to find out a suitable alternative for hot mix technology.

In the emulsion based cold mix technology, the addition of pre-wetting water to the aggregate, thereafter addition of emulsion to it, production of the mix, laying and compaction, all processes are done at the room temperature (23C to 25C). In addition to this, field trials have proved that cold mix can be easily produced by using hot mix plant and laid in using similar techniques. It is also a labour friendly technology. Uemura and Nakamori (1993) conducted both laboratory and field studies on cold mixes and concluded that cold mixes were more environmental due to elimination of dust and gaseous emissions as the aggregate and emulsified asphalt did not have to be dried for use in mixture. They also found the performance of cold mixes in an acceptable level.

Dittmer (2011) observed that cracks formed in cold mix asphalt pavement repaired themselves over time. He also recommended that because of this flexibility of cold mix surface it could last longer on low volume roads than hot mix. Needham (1996) suggested the production of cold mix for a range of different applicational purposes. Cold mix can be used mainly for base course and sometimes for binder or wearing course. Cold mix can be applied through a number of methods ranging from hand application through graders, finishers or pavers to self contained mixing and laying plants. Oke (2010) suggested that among varied compaction methods in field, the preferred method seems to be steel rolling, followed by very heavy pneumatic tyred roller and finally finishing with steel rolling.

Many researchers (Needham 1996, Ibrahim 1998, Thanaya 2003, Thom 2008) in this field had recommended cold mix asphalt to be much more efficient than hot mix asphalt in terms of energy savings. Besides this, Zoorob and Thanaya (2002) recommended cold mix asphalt mixtures to be more universally accepted for low to medium traffic conditions, for works in remote areas and for small scale jobs such as reinstatement work and footways.

II. ADVANTAGES OF COLD MIX

Cold mix is a mixture of unheated aggregate and emulsion or cutback and filler. The main difference between cold mix and HMA is that aggregates and emulsion or cutbacks are mixed at ambient temperature (10° C-30° C) in case of cold mix and aggregates and binder are mixed at high temperature (138° C-160° C) in case of HMA. Dense graded cold mixtures have far lower permeability and good resistance to deformation. Open graded mixtures are storable and semi dense mixtures have good adhesion and lower permeability.

Cold mix when used as paving mix can offer following advantages.

- It eliminates heating of aggregate and binder.
- It is environmental friendly and conserves energy. Cold mix pavement can provide energy savings of over 50% compared with hot mix [5]. So it can be considered as green bituminous mix for rural road construction.
- It can be easily prepared using small set up on site. It can be produced manually for small scale job. Laying of HMA for rural road construction sometimes is not economical because setting up of a hot mix plant for small scale job increases the project cost.
- This paving mix is particularly suited for construction of roads in remote and isolated areas of a country where plant produced hot mix may have set before reaching site.
- Cold mix can be laid during wet or humid condition also.
- It is versatile also as a large number of grades of emulsion and cutbacks are available.
- It is economical and high production is possible with low investment.

III. USE OF COLD MIXES IN RURAL ROAD CONSTRUCTION

Construction of rural road using conventional paving mix is sometimes not feasible in high rainfall area because it is difficult to produce and lay HMA. In case of high altitude or snow bound area, lower temperature of environment makes difficult to heat aggregate and binder at high temperature. In case of hilly roads, HMA is supplied from remote HMA plant; it is difficult to maintain mix temperature for long hauling distance. Cold mix can be produced on site. Simple concrete mixture, motor pavers or specialized mixing plant can be used to produce cold mix on site. Cold mix can be lay down by hand for small scale job and compaction is carried out by vibrating roller. North Eastern States of India belong to hilly area and sometimes roads go through forest zone. Due to its topographical constraints and environmental rule and regulation, use of cold mix may be a promising mix under different site conditions. Field trials have been carried out by CRRI at some location in North Eastern States of India. Cold mix is gaining considerable popularity in rural road construction.

IV. PLANT

Diagram of Hot Mix Plant:



Cold Elevator from Cold Feed Bins to Dryer



Bitumen Tank



Heating of Mix



Composite Mix

V. CONCLUSION

We conclude that, Cold mix can be laid on low to medium volume road as a green paving mix. Mixture can be produced by using conventional plant or by hand. So it can be laid as surface course or bituminous base course for rural road construction. Additive can be used in cold mix to make its properties comparable to the properties of HMA. Curing rate and mechanical properties of cold mix can be improved. Cold mix can be tried for paving mix in north east region of India.

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