WARM MIX ADDITIVE

Dr Praveen Kumar, *Professor & Coordinator, Transportation Engineering Group, Civil Engineering Department*
Indian Institute of Technology, Roorkee (Uttarakhand)

A bituminous mixture is a combination of bituminous materials (as binders), properly graded aggregates and additives. The bituminous mixtures are divided into four types according to the mixing temperature, as shown in Figure1.

a) **Cold mix:** produced at near ambient temperature.

b) **Half Warm Mix Asphalt:** produced at less than the boiling point of water (100°C) but the mix is still heated.

c) **Warm Mix Asphalt:** produced at temperature lower than 20° to 30°C of traditional HMA but still the temperature is more than the boiling point of water (100°C).

d) **Hot Mix Asphalt:** produced at temperature 140° to 163°C depending on many factors but mainly on the grading of bitumen. In the case of modified bitumen (MB) or crumb rubber modified bitumen (CRMB), the production temperature of the mix is higher and can extend up to 180°C.

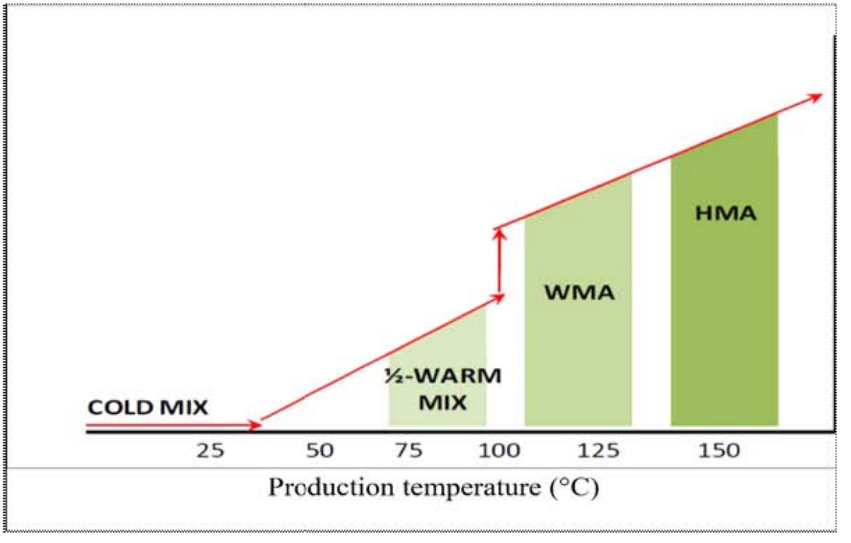

Figure 1Asphalt mixtures classified by temperature

Warm mix technologies allow significant lowering the production and paving temperature of the conventional hot mix asphalt. Most of thework on WMA has involved dense-graded mixture; however, in principle, WMA technologies are equally applicable to other types of asphalt mixture (e.g., open-graded, and SMA). Warm stone matrix asphalt (WSMA) reduces the mixing and compaction temperature with similar or better strength, durability and performance characteristics as SMA.

Warm Mix Asphalt (WMA) refers to asphalt concrete mixture that is produced at alower temperature than Hot Mix Asphalt (HMA). Generally, it has been observed that the Warm Mix Asphalt has temperature 20°C to 30°C less compared to HMA. The main goal of WMA is to reduce the mixing and compaction temperatures with similar or better strength, durability and performance characteristics as HMA.

The workability of WMA at low temperature can be improved by reducing the viscosity of binder or decreasing the frictional resistance between binder and aggregate. On this basis, there are three types of warm mix additivesas explained below.

a) Organic warm mix additive: the additives, which have melting point less than the normal production temperature of HMA can be added to reduce the viscosity of the asphalt. Example –Sasobit, Asphaltan-B, Licomont BS-100.

b) Chemical warm mix additive: the additives, which reduce the internal friction between the binder and aggregate particles during mixing and compaction but don't rely on the principles of foaming or viscosity reduction. Example–Evotherm, Rediset, Cecabase etc.

c) Foaming warm mix additives: These additives are of two types; water bearing additives and water based process. The water bearing additive contains synthetic zeolites, which are composed of alumina silicates and alkali metals. The synthetic zeolites have crystalline water which is released at more than 100°C that creates the foam in a binder and increases the volume of the binder and reduces the viscosity. Examples are Aspha Min and Advera. The water-based process utilizes water only to generate bubbles when contacting the hot binder. Examples are Double Barrel Green, WAM Foam, Green Machine, LEA.

Worldwide there are around 30 types of warm mix additives and technology.

The present study utilizes three additives namely Sasobit, Evotherm and Rediset

BENEFITS OF WMA

There are following advantages of WMA over HMA:

- Significantly lower mixing and compaction temperature
- Low energy consumption
- Less aging of binder

- Reduced thermal segregation in the mixing
- Decreased emission /odors from mixing plant and during placement
- Extending paving season
- Extended mix haul distance
- Improved working condition

DISADVANTAGES OF WMA

In some of the studies, it has been found that the moisture susceptibility problem occurs due to the fact that at lower mixing and compaction temperatures the aggregates do not dry completely. Also, researcher are not in agreement on the issue of density. It is not clear whether the satisfactory density can be achieved or not at lower temperature. The Foaming WMA technologies need modification in HMA plant. It may result in the high installation or modification cost.

Warm mix asphalt (WMA) was introduced in Europe in 1997 and in the United States in 2002. The first trial of WMA was done publicly in 1999 in Europe and in 2004 in the US. The present study was conducted by Mr Rajiv Kumar for his Ph. D. work (1) at IIT Roorkee, archived the use of non-foaming warm mix technology including Sasobit, Rediset and Evotherm with bituminous binders VG-30, PMB-40 and CRMB-60. The additive was blended with the asphalt binder using low shear mixer. The basic tests on asphalt binder were conducted according to Indian Standards. Preliminary tests showed that the softening point, penetration value, and absolute viscosity of the VG-30, PMB-40 and CRMB-60 change with warm mix additives. It has been observed that by adding Rediset and Evotherm, the softening point value slightly increases with doses while penetration value decreased with increase of dose of these additive. These changes were quite significant in the case of Sasobit. The mixing and compaction temperature (MACT) of asphalt binder with and without warm mix additives are determined using three different methodologies (traditional approach, high shear rate and zero shear viscosity). The effects of compaction temperature on properties of stone matrix asphalt mixture containing the warm mix additives has also been studied. The results showed that the warm mix processes were effective to improve the volumetric properties of SMA mixes.

To evaluate the rutting potential of asphalt binders, different tests were conducted. These included performance grade parameter G*/ Sinδ, zero shear viscosity (ZSV), multiple stress creep recovery (MSCR), repeated creep and recovery (RCR) and multiple stress creep and recovery (MSR). The results are very encouraging and may pave the way for reduction in Environment Pollution by heating the bitumen at lesser temperature.

Reference

Kumar Rajiv, Development of Warm Mix Asphalt, Ph.D. Thesis, Indian Institute of Technology, Roorkee, 2017