WARM MIX ASPHALT (WMA)

Frequently Asked Questions

1. What is the definition of WMA?

   Answer – Very simply, WMA technologies allow the mixing and placing of asphalt mix at temperatures significantly lower than those used with conventional hot mix asphalt (HMA). These technologies reduce the viscosities of the asphalt mix and provide complete aggregate coating at temperatures 35 to 100^0 F lower than HMA.

2. What are the primary benefits of WMA?

   Answer: The range of potential benefits includes:
   - Lower fuel cost
   - Reductions in VOC and Greenhouses gas emissions
   - Ability to pave in cooler conditions
   - Longer haul distance tolerance
   - Extended paving season
   - Easier raking
   - Improved performance life through better compaction
   - Reduced pavement permeability
   - Improved crack resistance through reduced binder oxidation
   - Lower worker exposure to asphalt heat and fumes
   - Lower mix cost though increased RAP usage
     - Conservation of natural resources through increased RAP usage
     - Reduction in foreign oil imports through increased RAP usage
   - Reductions in project life through increased efficiencies in daily production
   - Elimination of bumps when paving over rubber crack sealants

3. Can WMA technologies be used to produce asphalt concrete at HMA production temperatures?

   Answer- Yes but many of the environmental benefits associated with WMA produced at lower temperatures (fuel savings, reductions in emissions, higher RAP contents etc.) may not be realized to the extent possible.

4. Is there a national effort underway to evaluate and promote the use of WMA in the U.S.?

Answer- Yes. In 2005 a National WMA Technical Working Group (TWG) was formed to oversee WMA development and field trials in the United States. The TWG is led by individuals in the public and private sectors who are committed to the development of Warm Mix Asphalt in the United States. Experts from the National Asphalt Pavement Association (NAPA), State Departments of Transportation (DOTs), Federal Highway Administration (FHWA), National Center for Asphalt Technology (NCAT), American Association of State Highway and Transportation Officials (AASHTO), and many others meet regularly to discuss issues and share knowledge for the advancement of Warm Mix Asphalt.

5. California has constructed pilot projects over the last five years. I am concerned that California is moving too quickly towards the full implementation of WMA. What have other states done to implement WMA?

   Answer - Per the recommendations of the national WMA TWG most states began using WMA by implementing WMA pilot projects followed by specifications that allow the Contractor an option to use WMA. The amount of time agencies dedicate to pilot projects varies from between states. Some of the WMA lead states such as Texas and Alabama and Florida constructed two – three years of pilot projects prior to allowing the Contractor option. Other states such as Washington relied on the experience of other state DOT's implementing a contractor option after less than one year of WMA trials.

   The Federal Highway Administration (FHWA) has begun a new initiative entitled "Every Day Counts" (EDC) where new technologies that can have major impacts are targeted for wider implementation. The FHWA has targeted Warm Mix Asphalt as one of the new technologies that merits special interest. The FHWA will measure the success of the EDC program by the number of states that have developed permissive specifications for Warm Mix asphalt, with a goal of 40 states by July 2010.

   The number of successful WMA projects in the U.S. will continue to diminish the need for extended lead times prior to the full implementation of WMA in the remaining states.

6. How do I know which WMA technologies are acceptable for use? Is there a standard approval process?

   Answer – Although many state DOT's have developed WMA technology approval guidelines a national standard for the approval of WMA technologies does not exist at this time. Some states have no restrictions on WMA technologies provided the post plant mix meets the required mix properties. Other states such as California, Texas, New York and Alabama have a WMA technology approval process that looks at both field performance and laboratory testing as conditions for approval.

7. Will WMA require additional monitoring and documentation?

   Answer: WMA should not require additional monitoring or documentation. Unlike WMA pilot projects, the contactor option specifications will be considered business as usual. Testing and inspection requirements will be very similar to the requirements for HMA.

8. I understand that performance tests properties of WMA may not match those of HMA. Is this true? If so, why is this? And how is this being addressed?

   Answer - In some instances WMA will yield different test results than HMA. Mix volumetrics, binder content and RICE typically yield the same results as HMA. Performance test such as stability and in some instances tensile strength ratio have been known to produce lower test values than HMA. The difference in test results is associative with differences in binder stiffness (oxidation) as a result of the lower plant production temperatures.

   Although higher rutting and lower moisture susceptibility test results would normally be of concern, actual field performance and analytical research data have not borne this out. To bring the test results in line with actual WMA pavement performance some States require plant produced WMA to undergo mixture conditioning prior to running performance test. Accordingly, Caltrans WMA specifications will require mixture conditioning in accordance with CT 304 prior to testing for stability and moisture susceptibility.

9. What are the principal differences between HMA and WMA in regards to production and compaction temperatures?

   Answer – WMA will be produced at various temperatures depending on the mix type, WMA technology used, haul time, ambient temperature and the desired mix temperature at the project site. Normally WMA will be produced between 230 and 275 F.

   The temperature at which compaction will begin and the specified density is achieved will be dependent on the type and dosage of the WMA technology used. Final compaction can be achieved at temperatures as low as 160 F.

10. How do we ensure accurate compaction utilizing current equipment and laboratory procedures, i.e. nuclear gauge at the jobsite and mix density values in the laboratory?

    Answer – As noted by the National Asphalt Pavement Association (NAPA), experience has shown that the placement of WMA is "business as usual". Compaction should be measured using the same procedures

you currently use. For Caltrans this would entail comparing field cores to the Theoretical Maximum Specific Gravity (RICE) values obtained from plant produced mix. Experience has shown that the level of density achieved with WMA will be equal to or better than that achieved with HMA.

11. Does using WMA eliminate the "tender zone"?

    Answer - No. Not unlike HMA some WMA mixes may exhibit a "tender zone" which is defined as a range of mix compaction temperatures during which the mix exhibits instability under the roller. WMA does not typically increase the occurrence of tender zones and can reduce the tender zone of many mixes depending on technology and production temperature.

13. Should I be concerned that the lower production temperatures will result in higher mix moisture contents?

    Answer - While excessive moisture in the asphalt mixture should always be of concern, mix moisture test have show no significant difference between HMA and WMA produced from the same aggregate (and mix design). Just as in the production of HMA, best practices for the control of aggregate moisture contents in stockpiles should always be employed for the successful implementation of WMA.

14. Should I be concerned that the water being added to the binder when using the mechanical foamed asphalt technology will result in excessive moisture in Warm Mix Asphalt?

    Answer – No. Excessive moisture in WMA mixtures produced using in-line asphalt foaming technology should not be of concern. The amount of water introduced into the binder is minimal; about 1.5% by weight of binder or approximately 0.075 percent by total weight of mix. When combined with the binder the water immediately flashes from a liquid to a gas. In turn, the binder undergoes a significant increase in volume due to the millions of microscopic air bubbles created in the vaporization process. Mix moisture test have show no significant difference between HMA and WMA. The small amount of moisture in the mix is a product of the residual moisture in the aggregate and not the asphalt foaming process.

15. Is there data that shows successful utilization of WMA?

    Answer – Yes. There is a significant amount of data showing the successful utilization of WMA. Over 45 states have constructed pilot projects using WMA. WMA has been successfully placed in all types of climates and traffic loadings. Texas, Alabama and Washington are examples of states with diverse climates and highway traffic loadings that have successfully constructed pavements with WMA. The Texas DOT has placed over 2 million tons of WMA while Washington DOT is approaching a 1 million ton milestone. Caltrans has constructed 17 WMA

pilot projects since 2006 and two Heavy Vehicle Simulator (HVS) test tracks. There is a wealth of information available from the Federal Highway Administration (FHWA), the National Asphalt Pavement Association (NAPA), and the National Center for Asphalt Technology (NCAT) to name a few sources. There have also been a number of independent laboratory studies performed with various WMA technologies.

16. Besides being environmentally friendly and having the potential to provide superior in-place air voids we are told that using WMA will reduce cost to the owner. Is this true; if so, how?

    Answer – There are essentially four areas of potential cost saving associated with the use of WMA; 1) reduced energy cost, 2) increased paving efficiencies, 3) increased service life and 4) use of higher RAP contents.

    Reductions in energy cost are typically offset by the additional cost of the WMA technology being used. In-line foamed asphalt systems may provide minimal cost savings but only after the WMA equipment capitalization costs have been recouped.

    Costs saving resulting from **increased paving efficiencies** are normally dependent on somewhat intangible parameters such as environmental and logistical conditions. Nonetheless, the cost savings to the owner can be significant when increased efficiencies are realized as a result of the use of WMA. For example, the ability to increase haul times and pave in cooler temperatures may allow for the completion of paving operations before cold weather results in the need to winterize a project. If anticipated at the time of bid this could result in considerable reductions in overhead and mobilization costs in the Contractors bid price.

    Research has shown that compaction is the greatest determining factor in pavement performance. Inadequate compaction results in pavements with decreased stiffness, reduced fatigue life, accelerated aging, decreased durability, rutting, raveling and moisture damage. By nearly all accounts it is easier to achieve the desired density with WMA as compared to HMA. Cost savings related to **increased service life** due to superior in-place air voids can be very significant.

    One benefit of WMA is the ability to incorporate **higher amounts of reclaimed asphalt pavement (RAP)**. WMA technologies can be beneficial to asphalt mixtures containing high percentages of RAP in several ways. First, the reduced viscosity will aid in pavement compaction leading to longer service life. Second, the decreased aging of the asphalt binder, resulting from the lower production temperatures, may help rejuvenate the RAP binder, increasing pavement service life without the concerns of cracking. Preliminary data from projects in Maryland where WMA was used to improve workability determined that there was a net

savings of $4.55 per ton when RAP was increased from 25 to 45 percent. Increasing the RAP content creates a win-win situation from both a performance and cost savings perspective. Like RAP, the use of Recycled Asphalt Shingles (RAS) in asphalt mixtures will also benefit from the use of WMA technology.

17. We are constructing a project that requires a 2" overlay of dense graded HMA over geosynthetic fabric. If we use WMA in place of HMA do we need to change the application rate or type of binder tack coat material to accommodate the change to WMA?

    Answer – No. The geosynthetic fabric is considered an inter-layer "stand alone system". Therefore there is no need to modify the application rate or type of tack coat material when using WMA over geosynthetic fabric. Experience has shown that WMA and HMA perform equally well over geosynthetic fabrics.

18. Do pavements constructed with WMA take longer to open after compaction is achieved?

    Answer - There is no evidence that pavements constructed with WMA take longer to open after compaction is achieved. When considering production temperature, ambient temperature and haul time and other factors, the fact that WMA can be compacted at significantly lower temperatures than HMA does not necessarily equate to longer compaction time. Once the desired density is achieved traffic can be placed on the pavement.

19. I'm concerned that giving the Contractor the option to select the WMA technology may result in the wrong product and/or dosage rate being selected. Should I be concerned?

    Answer – If the project can be constructed using HMA it can be constructed using any of the WMA technologies identified on Caltrans approved WMA technology products list. Like HMA, when selecting a WMA technology and dosage rate the Contractor will take into consideration all the necessary precautions normally exercised to achieve a well constructed pavement. Those considerations would include; mix type, mix production temperature, ambient temperature, wind velocity, haul time, and lift thickness. Because WMA typically acts as a compaction aid the ability to achieve the target in-place air voids will often times be easier with WMA for a given set of environmental and project conditions.

20. I'm concerned that the Contractor my not introduce the WMA technology in accordance with the manufacturers recommended procedures. Are there steps to prevent this from occurring in the specifications?

Answer: The specifications require the WMA additives to be introduced in the mix in accordance with the manufactures recommendations. The WMA equipment must be in compliance with Caltrans Materials Plants Qualification Program (MPQP).