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TxDOT PERSPECTIVE ON WARM MIX ASPHALT

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I am frequently asked what I think of Warm Mix Asphalt (WMA). I am also asked about the future direction of WMA from a DOT perspective. I cannot speak for all of TxDOT, but I can share my personal thoughts and opinions on WMA as well what I think the future direction of WMA will be.

Background and Discussion

WMA has only been used in Texas for approximately 2 years now, however; I think it is fair to say that the use of WMA is way past the experimental stage. In fact, there have been what is estimated to be over 200 WMA projects constructed in the United States to date. In Texas alone we have used at least 5 of the 11 known WMA technologies on projects ranging from less than 500 tons to over 75,000 tons. By the end of this construction season, I would estimate that we will have placed over 200,000 tons of WMA in Texas spread out over at least 12 projects and at least 6 TxDOT districts. This leads us to the question of "where is TxDOT going with the use of WMA". While no one can accurately predict the future, I have come to the point that I believe we are going to see an exponential increase in the use of WMA in the near future. At the current pace that WMA technology is moving we may soon get to the point that it no longer makes sense to produce hot mix above 300F°. There is no doubt in my mind that we are in the midst of a significant paradigm shift concerning production and placement temperatures for asphalt mixes.

What's Next for WMA in Texas?

When we were first approached about the possible use of WMA in Texas, the Construction Division and TxDOT administration took the stance that WMA would be allowed as long as it met our current hot mix asphalt (HMA) specifications. In fact it would be very difficult for TxDOT to not allow WMA because other than observing lower production and placement temperatures there are not many ways of detecting that the mix has a WMA additive. The only language in our current HMA specifications that could be viewed as restricting the use of WMA is contained in Table 11 of Item 341 (and the other hot mix specifications), which states the "Minimum Suggested Mix Temperature Prior to Entering the Paver." Although there is some ambiguity, generally speaking we do not interpret this as an enforceable requirement because of the word "suggested" which implies that there is latitude in the requirement.

In order to clear up the ambiguity in our current HMA specifications our administration has asked that we write special provisions that will make it clear that WMA is allowed on all TxDOT projects and that WMA could be required when specified. These special provisions have been written and are currently being considered for approval by TxDOT's specification committee.

What's in it for The Contractor?

By almost all accounts when WMA is used the producer saves money on fuel costs and the contractor is able to obtain better compaction (typically 1% - 2% higher in place density) which translates into higher QCQA bonuses. Often times, contractors report not having to use as many rollers or as many roller passes. This can translate into increased production. At some point depending on the cost of the WMA additive, contractors may be losing money by not using WMA. For example on an SMA job in Texas (Item 346): a contractor receives a 1.000 placement pay adjustment for achieving a 94% in place density. At 95% in place density the placement pay adjustment is 1.050 which is a 5% bonus and at 96.0 in place density the contractor receives a 1.100 placement pay adjustment which is 10%. Since half the over bonus is based on the production bonus (lab molded density) and the other half is based on the placement bonus (in place air voids ie. field density), an increase of 5% for the placement bonus translates to a 2.5% overall increase in pay and an increase of 10% translates to a 5% overall increase in pay. Assuming the bid price of the SMA is $80/ton, a contractor can make an addition $2/ton for getting 1% better in place density and $4/ton for getting 2% better in place density. Under this same sce-

nario for conventional mixes (Item 341), the placement bonus would be cut roughly in half since the maximum bonus is 5%. It is easy to see that if a contractor can achieve a better in place density they can make more money. If you add this savings to the fuel cost savings (typically reported to be about $1/ton or more) and the increased production rate there is a significant amount of money to potentially be saved.

What's in if for TxDOT?

There are at least 2 major benefits that TxDOT can realize from the use of WMA. The first and maybe most important is that there is a significant reduction in the amount of oxidation that the mixture is exposed to during the production process. Less oxidation should translate into longer pavement life. It is estimated that the asphalt oxidation is cut 50% for every 25°F reduction in the production temperature. Most WMA additives or processes cut the production temperature by 50°F to 100 °F. For example: a mix produced at 230°F would have only 1/8th of the oxidation compared to the same mix produced at 330°F. A less oxidized asphalt is essentially a softer asphalt which could translate into better resistance to cracking.

As stated earlier, contractors typically report getting 1% - 2% higher in place density when using WMA. While this earns the contractor a larger QC/QA bonus, it should provide TxDOT with a longer pavement life because there have been many studies proving that fatigue life is highly related to in place density. It is certainly in TxDOT's best interest that the contractor achieve better in place densities.

Environmental Benefits

There have been numerous emissions studies showing that WMA significantly reduces the amount of green house gases that are generated during the production of HMA. It has also been observed that as production temperatures dip below approximately 275°F, the blue smoke that is associated with many HMA jobs essentially disappears which indicates that the "lighter ends" of the asphalt are not being cooked off during the production process. Clearly, the benefits of WMA are a "win/win" situation for environment as well as the asphalt pavement itself. It is easy to predict that environmentalists will and have been quick to embrace WMA. Pessimists say that the environmentalists will soon find ways to mandate lowering emissions from HMA plants but I tend to believe that the engineering and economic benefits of WMA will lead us to lowering emissions long before we are ever forced to do so. The optimists actually predict that WMA will make it easier to get a permit for a hot mix plant since the emissions are significantly lower. The bottom line is that WMA is good for the environment period.

Extending The Construction Season

WMA functions as a compaction aid for asphalt mixtures. With WMA additives, compaction can still be obtained when the mat temperature is in the low 200°F range. This is a benefit to both the Contractor and TxDOT because it can allow us to start some paving projects a little earlier in the spring or extend them a little longer into the fall. In fact, the traveling public is the main beneficiary of an extended paving season because more paving projects can be completed in a timely manner. This is not to say that we can now pave in any weather just because WMA makes it easier to obtain compaction. I have stated many times that we still have to be concerned about obtaining a good bond between the hot mix and the underlying in order for the pavement to perform adequately.

Advantages of Combining RAP and WMA

One of the main arguments that some give for not wanting to use RAP is that aged (oxidized) asphalt (in the RAP) can take away from the life of a new HMA mixture. This becomes a significant concern when using higher RAP percentages (> 25%). The primary benefit of combining RAP and WMA is that the "under oxidized" WMA essentially counteracts the "over oxidized" RAP. With current asphalt prices at record highs, it makes good economic sense to try to maximize the amount of RAP that is used in HMA and warm mix additives can help facilitate the use of more RAP without sacrificing performance.

DOT Concerns/Issues

Up to this point I have painted a rosy picture of WMA and you might wonder why we are not already using it on more projects. There are a few remaining challenges that we still face. In some cases, WMA mixtures have had difficulty meeting the current Hamburg requirements and some attribute this to the "under oxidizing" of the asphalt binder. It has even been suggested that we might have to "bump up" the asphalt grade in order to achieve the same overall stiffness. In my opinion, this is not a practical or cost effective solution. Fortunately, all of the recent WMA jobs have not had issues with passing the Hamburg requirement. I often hear concerns about the WMA additives or processes that add water to the hot mix because we have all learned over the years that water and hot mix do not mix and that moisture damage can occur. One quick thing to point out is that the amount of water that remains in the mix when using WMA is roughly equivalent to less than one syringe full of water in every ton of HMA. On WMA jobs where we have tried to measure the moisture content in the mix, we typically get either zero or less than 0.1% moisture in the mix.

One issue that we have seen on most WMA projects is that the lab molded density is usually slightly higher than what we experience with conventional mixtures It is recommended that the laboratory samples be compacted at the production temperature.. Achieving reasonable lab densities has not been a major problem since many districts have already raised their target density to 96.5% or 97.0% in order to get more binder in their mixes. It does however remain an issue that has to be properly addressed and could potentially be an issue on future projects.

A final concern is that there is a proliferation of WMA products coming onto the market. Last year there were only 3 or 4 major WMA suppliers, now there are at least 11 on the market. WMA additive prices have come down significantly in the past year or two. Depending on which process is used, the additional cost per ton of hot mix is now typically in the $0 - $3 per ton range. This is good for competition but it raises some questions about whether or not we need an official approval process for WMA additives and processes.

Conclusions

My ability to predict the future is questionable and often wrong but barring any unforeseen obstacles, I expect to see WMA additives or processes used on most if not all hot mix projects in the not too distant future. This is coming a long way from someone who two years ago (when the additional price was about $5 ton) predicted that we would allow WMA but that we would never pay the additional cost and that contractors wouldn't either. TxDOT has now actually specified WMA on 4 projects and WMA is being allowed at the contractors request on a number of projects across the state. My experience has been that the contracting industry is typically slow to embrace change which is why I am somewhat amazed at how quickly WMA has been embraced by contractors and asphalt producers. At this point, it is hard to see WMA not succeeding because there is way too much to gain for the asphalt paving industry and TxDOT as well. As I stated earlier, we are on the brink of a major paradigm shift in the asphalt paving industry concerning production and placement temperatures and I think we will all likely look back in a few years with amazement on how quickly the change occurred.