## Long-Life Asphalt Pavements for the 21st Century - Warm Mix Asphalt Technologies

Neelam Patel: OK. This is Neelam. I'll just take a quick minute to introduce Matt. And again, I encourage you to submit your questions electronically with the name of the presenter that you'd like to ask the question to. So our next speaker is going to be focusing on sustainability initiative with asphalt pavement. Matthew Corrigan is an asphalt pavement engineer for the Department of Transportation, Federal Highway Administration. And prior to joining the Office of Pavement Technology, he was a construction project engineer with Federal Highway Administration's Central Federal Land Highway Division, in charge of the road and bridge construction inside U.S. National Parks and Forests. So Matt, if you'd like to begin your presentation, we'd love to hear more about this emerging technology.

Matthew Corrigan: Sure. Is it – is it up? Can everybody see it?

Nikhil Nadkarni: Yes.

Neelam Patel: We sure can.

Slide 1: Title Slide

Matthew Corrigan: OK, great. Thanks for the welcoming and the introductions. I'm going to give a brief overview on one of the areas that we have worked on here in the Office of Pavement Technology in implementing new technologies for pavements this emerging area of warm-mix asphalt. And just so that everybody is aware, the primary focus of our office, Office of Pavement Technology, is really on the performance of these technologies and the materials that are used to make sure that we get a long life out of the pavements.

Slide 2: WMA Investigation and Implementation Premise

Matthew Corrigan: And we recognize that there are many factors driving the technologies, things that have already been discussed today. You know, environmental sustainability. But the primary purpose, that the industry really was looking at these technologies moving forward, was to reduce the amount of energy needed to produce the mixtures as well as reduce the localized fumes at the production facility.

Slide 3: What is WMA?

Matthew Corrigan: So what is warm-mix asphalt? Well, in a nutshell, it allows us to produce asphalt mixtures at lower temperatures and there are multiple ways to do that. Some of the technologies basically reduce the viscosity or make the liquid asphalt, the black sticky stuff, less sticky, if you will, to where you can still fully coat the aggregates or the rocks at lower temperatures. Traditionally, our hot-mix asphalts, we need the elevated temperatures and the energy associated with that not only to heat up the rocks in order to coat them, but also to

provide that heat exchange to the liquid binders so that it is fluid enough, that it is workable as we produce it and then transport it to the job site and then actually pave it on to the roadway.

Slide 4: WMA Temperature Ranges

Matthew Corrigan: Other technologies that have just recently been developed - we're still trying to fully understand the mechanism that allows us to take advantage of producing them at the lower temperatures because it's not always a reduction in viscosity that quantifies what that is. But across the board, they all allow us to reduce the temperature to different varying degrees from our traditional hot-mix asphalt pavements. So what you see here is something in the neighborhood of the general temperatures that we're looking at when we produce hot-mix asphalt versus warm-mix asphalt versus even cold-mix asphalt which traditionally is being used in maintenance area and pothole patching and things of that nature.

Slide 5: WMA Comparison

Matthew Corrigan: The technologies are very much different when it comes to the amount of temperature reduction, some of the technologies hovering about that 275, 265 range. Others really push the envelope and you can reduce the temperature down below 200 degrees Fahrenheit. So it very much depends on the technology. The localized fumes are very easily to see the – very easy to see the reduction. Here, if you look at the picture on the left-hand side, that's a traditional hot-mix asphalt being produced at 320 degrees Fahrenheit. And on the right-hand side, it's using a warm-mix technology where they reduce the temperature to 250 degrees Fahrenheit. And you can just see, visually, the localized fumes at the production site do get reduced with the reduction in temperature. And so that's been one of the drivers in addition to just reducing the energy needs and producing the mixtures at these higher temperatures as well.

Slide 6: Brief U.S. History

Matthew Corrigan: So just a brief U.S. history to let everybody know where we're at – most of these technologies came out over – at least were first developed in – and acknowledged in the European community. They were discovered early on by the National Asphalt Pavement Association on some of their different scanning tours and brought to the United States in San Diego as part of their annual meeting in 2003. And that's when I got involved as well as Federal Highway and the Office of Pavement Technology on looking at ways to implement the technologies with the goal of maintaining that long-term performance.

The Board of Asphalt conference, which is held every year, was one of the first demonstrations of the technology in the United States. We formed a technical working group around the technologies - Federal Highways Administration and NAPA in 2005. And then the Federal Highway Administration did an international scan tour which you see the report here on the right-hand side. That's available if you search our internet site or international program site for warm-mix. You'll be able to download that European Practice Guidance. And then we had an international scan tour, November of 2008, to kind of bring all these guidance together to the industry.

Slide 7: Why WMA?

Matthew Corrigan: So you can see, we've got a few years under our belt with acknowledging the technology and its usage, but it's really only been within the last three years that we've seen the pavements actually being produced on the roadways. These are the potential advantages that are typically being touted as far as moving towards warm-mix asphalt. And of course, if you see with the asterisk that, really, the only way you can take advantage of all of these advantages is to optimize the production operations. Producing asphalt mixtures is a complex process, and there is a lot of information that needs to be exchanged between the operation as well as lay down in order to achieve all of these results. And like I had mentioned, the energy savings in the decreased fumes are really kind of the two major movers. But there's other identified potential advantages.

Slide 8: Why WMA?

Matthew Corrigan: What's really kind of out there as far as the verdict, still needs to be determined is how much energy savings. We recognize that just by reducing the temperature, we do get decreased emissions and decreased fumes. But, from a life-cycle cost analysis standpoint, if we're not able to get the same performance as our hot-mix asphalt, and we have to go out there and build them more frequently, then in fact, things like energy usage and emissions in the long term in a life-cycle basis could increase. So again, as part of optimizing this process and really identifying how much energy savings, how much decreased emissions and fumes we're getting.

As well as things as increasing the recycled asphalt pavement content in our mixtures, there is a continuing research and study being done right now to address whether or not we can activate the recycled asphalt pavement in the mixtures at the reduced temperatures. And so these are still some of the potential advantages, that we acknowledge, come with lower temperatures. But we want to make sure that, indeed, we are getting the long-term performance and these are coming to realization.

Slide 9: How Many WMA Technologies are Available?

Matthew Corrigan: What makes this very difficult is, that, when we first started looking at the technology in the United States, there were only three warm-mix technologies available at that time.

Slide 10: How Many WMA Technologies are Available?

Matthew Corrigan: Currently now, as of my last count, which was about two weeks ago, we've got currently 20 different named warm-mix asphalt technology being marketed and used in the United States. And so being able to quantify their performance of all these technologies is going to be a difficult task for the industry to keep ahead of.

Slide 11: Technology Overview

Matthew Corrigan: This would be page one of the two pages recognizing the different technologies. Unfortunately, I don't have enough time within the context of this presentation to give you a lot of details on how each of these technologies work. But, you can really differentiate them in three major ways.

There are a couple of technologies, the WAM-Foam and the low-emission asphalt that basically they take, with some additional equipment at the production facility. They change how the existing materials for hot-mix are incorporated or processed in the production process. And so it's really just a different way of manufacturing the material. The other technologies here on the left-hand side, as you work down including up to the ready set, are what would be additives, either a chemical, or waxes, or something that's added to the mixtures or to the liquid asphalt, that allows you to reduce the temperature.

Slide 12: Technology Overview

Matthew Corrigan: And then you get into these technologies here on the right-hand side, which are primarily what they call "foaming technologies," where you're injecting some amount of water into the liquid asphalt, and it creates a rapid expansion, or a foam-kind of like a shaving cream type of consistency to allow us to produce at the lower temperatures. And of course, Federal Highway, we do not endorse any particular technology that's being marketed. These are the final ones that have just come out and these two are, again, they're admixture types. This is another foaming technology and another admixture type here.

Slide 13: WMA Trials and Demonstrations

Matthew Corrigan: And there are certainly more technologies being used internationally in Europe, in Australia, in South Africa, South America. So there are plenty other technologies being used around the world. To date, we've seen a lot of states get into the area of looking at the technologies and producing at least some small projects or demonstration projects. The yellow states are the states that have been identified by us as actually doing some sort of demonstration project. Now many of these projects, especially in the first couple of years, 2005 and 2006, were very small projects, low tonnage, low lane miles, not heavily trafficked routes. So it wasn't really until about the end of 2005 or rather, the end of 2007, 2008, 2009, that we've picked up larger projects, larger production, larger lane miles with heavily trafficked routes such as interstates.

So we're still, again, evaluating this long-term performance. And through that evaluation, our mobile asphalt mixture testing laboratory, which you see here, tractor-trailer pulled laboratory, we've been able to visit several of these warm-mix demonstration projects in order to evaluate the materials and the performance, and continue to monitor those sites, as far as how long they will perform under traffic. Right now, there are over 140 documented projects in some format. But like I said, most of those have been very small projects, up until the last couple of years. So we're really just starting to see the technologies take off.

Slide 14: WMA Technical Working Group

Matthew Corrigan: To make sure that we're giving information out on the proper usage of the technologies as well as the benefits and precautions on possible improper uses, we develop the technical working group. I help co-chair that as well as some industry representative. But it's a very broad, diverse representation of the industry, including our state agencies, asphalt pavement associations, AASHTO, labor, NIOSH, different academic groups. So we're really trying to get as much input into this process as possible.

Slide 15: WMA TWG Accomplishments

Matthew Corrigan: Some of the accomplishments that we've been able to do in a short amount of time is develop the warm-mix asphalt website and you can get a lot of information. In fact, most of the information and the rest of these bullets can be accessed there. We've got some recommendations on testing, as well as best practices for producing, using the technologies and a guide specification for state agencies to use constructing pavements.

Slide 16: National Research Initiatives

Matthew Corrigan: We've also managed to move forward many research-need statements on a national front that have been submitted to AASHTO, and the five research need statements we have put forward have all been funded through AASHTO, through the National Cooperative Highway Research Program, to a total of nearly $3 million. So you can see there's a large emphasis and a large need for knowledge in this area. These are the - the five research-need statements have been combined into three major projects by the NCHRP process, the 9-43, 9-47A, and the 9-49 projects. And really, again, the emphasis here is to understand the technologies, and make sure we're getting long-term performance.

The 9-43 project is about ready to finish here at the end of the spring, beginning of summer this year, which is developing a mixed design procedure for the technologies. The 9-47A is just getting started. But it's really looking at benchmarking the energy savings, to energy audits, as well as the emissions reductions, so that we don't just get a lot of marketing spin on what kind of reductions we can realistically see with these technologies. So this will benchmark those on a handful of well-controlled and select projects, as well as monitor the short-term field performance, again, making sure that we've got equal to or better performance than our conventional hot-mix pavements.

And then the 9-49 project is just getting underway as well. The phase one has been advertised on looking at whether some of these technologies, due to the lower temperatures, are more prone to moisture-susceptibility damage, which would reduce the performance, and recognizing whether or not that's an issue or not, and how to mitigate those. So again, a lot of national research being done, and a lot of questions on long-term performance still remain to be answered.

Slide 17: Written Summary of WMA

Matthew Corrigan: Unfortunately, again, due to time constraints, I can't get into too much more detail, but, we've put together a kind of a written summary on the technologies, and a lot of links

to the different research work, the warm-mix asphalt technical working group. And of course, my contact information there is available. So I'd encourage those of you that want more information to please visit our website. And with that, I'll turn it back over to the chair.