

## Introducing Warm Mix Asphalt

By: Amie L. Broadsword, PE, LEED AP

### What Is Warm Mix Asphalt?

Warm mix asphalt (WMA) is an exciting development in asphalt technology, allowing production and placement of asphalt paving at cooler temperatures than hot mix asphalt (HMA). WMA technology is made possible by utilizing an additive that thins or reduces the viscosity of the asphalt binder at cooler temperatures, allowing sufficient coating of aggregates while maintaining workability. Typical composition of warm mix asphalt is the same as for the hot mix variety, except for the additive utilized in warm mix applications to lower the viscosity.

### Why Use Warm Mix Asphalt?

Having a cooler asphalt mix is central to the multiple benefits of using WMA. The most obvious benefits are reduced energy use at the mixing plant due to cooler mix temperatures, and the resulting decrease in both odor and emissions from production to installation. These benefits are why WMA is largely an industry-driven change in technology, with many suppliers focused on completing retrofits to bring this technology to market sooner.



WMA Paving on 4th Ave S. (note lack of fumes)  
Photo Credit: City of Seattle

Other important benefits include an extended seasonal paving window and hauling radius. These benefits are made possible because of the reduced temperature differential between WMA and ambient temperature. Because WMA cools slower than HMA, reduced thermal segregation and decreased binder aging likely contribute to a longer service life of paving projects.

### History of WMA

Although relatively new to the Pacific Northwest, WMA has been used successfully in Europe for more than 15 years. In 2002, the National Asphalt Paving Association (NAPA) first brought warm mix technology to the United States, inspiring significant interest in the U.S. market. More recently, the Federal

Highway Administration and NAPA formed the WMA Technical Working Group, the mission of which is to evaluate and validate WMA technologies and to implement proactive WMA policies, practices, and procedures that contribute to a high-quality, cost-effective transportation infrastructure. As a result of this partnership, numerous pilot WMA projects have been tested across the United States. Current topics of research include long-term performance, thermal cracking, short- and long-term aging effects, additive specifications, and performance grade binder specifications. Further information on this technical group can be found at [www.warmmixasphalt.com](http://www.warmmixasphalt.com).

### What Technologies Are Available?

Currently, there are numerous technologies available to increase mix workability at lower temperatures for the production of WMA. Most technologies involve the addition of a chemical or plain-water additive to emulsify or foam the oil, allowing a reduction in viscosity and an even coating of the aggregate mix. Standard hot mix temperatures range from 325 to 350 degrees Fahrenheit. The reduction in temperature for producing WMA typically ranges from 30 to 100 degrees below typical HMA temperatures.

Locally, Washington State Department of Transportation (WSDOT) Standard Specifications allow additives as approved by the engineer. The Seattle Department of Transportation (SDOT) has developed a specification for WMA that allows the contractor to select from the following technologies:

- Organic additives (including waxes)
- Water-bearing zeolites
- Water-based foaming processes
- Emulsion-based processes

Each technology has different requirements with regard to how the additive is added to the asphalt mix. The WMA Technical Working Group has also published sample WMA specifications for agencies to use as a guideline.

### Local WMA Projects

Over the past two years, WSDOT has completed approximately 20 paving projects that utilized WMA. Its permissive specification allows the contractor to consider use of any one of the nationally recognized WMA technologies; however, the contractor must still submit a proposal to WSDOT for review and approval. According to Joseph DeVol, WSDOT bituminous materials engineer, "We will continue to allow interested contractors to use WMA in lieu of

HMA as long as we do not see reduced service life or performance related to failures attributed to WMA.”

In 2009, WSDOT installed an approximately four-mile-long test section of WMA overlay on the eastbound right lane of Interstate I-90 near George, Washington. The project consisted of grinding the existing pavement and inlaying it with three inches of WMA. In total, the project utilized 4,724 tons of WMA at a cost of \$64 per ton. The paving contractor was Central Washington Asphalt. This site is being monitored and test results will be reported by WSDOT five years post-construction.

SDOT is providing an option for use of WMA on certain approved overlay projects as appropriate. Since 2009, SDOT has completed three such overlay projects, totaling 4,180 tons of WMA at an average cost of \$90 per ton. Lakeside Industries and Icon Materials were the paving contractors used. These projects were selected to test a variety of conditions, including different subgrade materials, topography, and traffic loading. Monitoring to date has been positive and SDOT has been pleased with the paving results.

For 2011, SDOT is proposing to pave approximately 13,100 tons (50% of its proposed capital projects asphalt tonnage) with WMA. It plans to complete several projects per year, including a test with a full-depth WMA reconstruction project. To date, SDOT projects have included only basic grind-and-overlay projects with minimal road base reconstruction.

### Cost Data

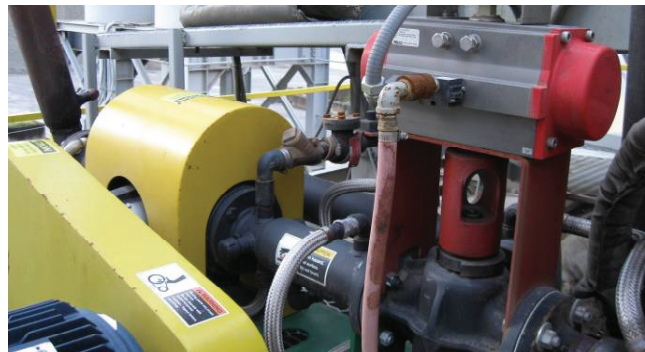
According to SDOT, there is currently an approximately 5% premium for use of warm mix asphalt. Although energy savings at the plant for completed test projects were close to 20%, natural gas prices are low and the cost of additives and plant upgrades are not offset by the energy savings at this time. This cost environment is expected to improve in the next five years as retrofits come online and fuel prices potentially increase. As an example of recent pricing, the low bid for an 1,800-ton asphalt pavement overlay of South Dearborn Street in Seattle was \$69 per ton for HMA, with an incremental increase of \$5 per ton for upgrading to WMA. Pricing is highly variable and is based on accessibility of the site and the total amount of pavement. However, the premium of approximately 5% on WMA has been fairly stable for pilot projects conducted by SDOT.

### Future of WMA in Pacific Northwest

Asphalt paving is the most common surface treatment for paved roads in Washington State. WSDOT

maintains approximately 11,000 lane miles of asphalt paving, and Seattle alone has 1,439 lane miles of asphalt roads. As local roadway infrastructure ages, there is clearly great potential for the use of WMA. And, as asphalt suppliers undertake plant retrofits to accommodate increased production of WMA and local agencies become more familiar and confident with its use, it appears this technology is likely to be the future of asphalt paving.

Lakeside Industries, a local asphalt supplier, is currently upgrading its Issaquah mixing plant with a water injection system to create WMA. This system upgrade cost approximately \$65,000 up front, but has a relatively short payback period due to the decrease in projected energy usage and the absence of a requirement to purchase chemical additives. This WMA technology adds water with the oil and runs the liquid through a shear mill to create an emulsified liquid that evenly coats aggregates. If the plant needs to run hot mix, it simply bypasses the water injection system and shear mill and heats the mix to a higher temperature.



Shear Mill and Water Injection at Lakeside Industries, Issaquah  
Photo Credit: Amie Broadsword, PACE Engineers, Inc.

This system will be coming online soon, with the expectation that, due to its many benefits, customers will switch to warm mix once it is readily available. This plant upgrade supports the growing industry-wide sentiment that warm mix asphalt will likely become standard practice.

### How PACE Can Help

PACE is dedicated to supporting technologies such as WMA that have a clear triple bottom-line advantage. As WMA technologies are proven locally viable and prices decrease to reflect energy savings, PACE is committed to helping clients realize the multiple benefits of WMA. For more information on how PACE can help with any of your site development and paving needs, please contact Amie Broadsword, PE, at 425.827.2014 or amieb@paceengrs.com.