Warm Mix Asphalt Pavements:

Technology of the Future?

BY WAYNE JONES, P.E.

Ever since the Warren brothers built and patented their first asphalt plant in Cambridge, Massachusetts, in 1901, combining aggregates and asphalt at elevated temperatures has been the accepted method of manufacturing hot mix asphalt (HMA). Now, as we move into the new century, is it time to update the technology that predates the Wright brothers' patent for the airplane? Is warm mix asphalt (WMA) the mix production technology of the future?

Jim Warren, Executive Director of the Asphalt Association of Florida, played host to 500 people at the WMA demonstration during the World of Asphalt in Nashville.

WMA Benefits

By lowering the viscosity of the asphalt binder at any given temperature, WMA technology allows the mixing, transporting and laydown process to take place at significantly lower temperatures. Using a WMA process, mixes can be produced at temperatures as much as 37°C (100°F) lower than traditional methods. The most obvious benefit of WMA is the reduction in fuel consumption and corresponding savings to dry and heat the aggregate.

Along with lower mix temperatures, WMA offers several additional benefits. These benefits include lowered emissions from the burning of fossil fuels, lower fumes and odor generation—both at the plant and the jobsite, and easier laydown and compaction operations. By shrinking the difference between compaction temperature and ambient air temperature, it may even be possible to extend the construction season. Early indications are that WMA technology can provide all these benefits without sacrificing the long-term performance of the asphalt pavement.

Background

Like many of the recent advances in the asphalt industry, such as Stone Matrix Asphalt, Porous European Mix, and Quiet Surfaces, WMA technology comes to the United States from Europe. The European Union (EU), under the terms of the Kyoto Agreement, has made a substantial commitment to reducing greenhouse gases produced by all manufacturing. Specifically, the EU has agreed to reduce CO_2 emissions by 15 percent by 2010. With this goal, the European hot mix industry has begun using WMA technology to construct asphalt pavements at much lower temperatures.

A small self-contained unit used to meter in the Aspha-Min® synthetic zeolite material was the only plant modification required to produce the WMA mix for the demonstration project.

Processes

The three most widely used technologies in Europe for producing WMA are all proprietary processes that vary greatly in their approach.

- Aspha-Min®, marketed in Europe by Eurovia, is a synthetic zeolite. This material is added as a fine powder during the mixing cycle at the asphalt plant to create a foaming effect in the binder. Chemically, zeolite is an aluminum silicate mineral with 18 percent water of hydration bound up inside. When added to an asphalt mix at approximately 0.3 percent by weight, the water is released gradually over time, resulting in an almost continuous foaming action. This foaming action of the liquid binder acts as an extender and lubricant enabling the mix to be workable at lower temperatures. Production temperatures can be reduced dramatically, down to the 130-145°C (266-293°F) range.

- WAM-Foam® (Warm Asphalt Mix Foam) is a two component binder system that introduces a soft binder and a hard foamed binder at different times in the mixing cycle during production. WAM-Foam is a joint venture product between Shell International Petroleum Company Ltd., London, U.K., and Kolo-Veidekke, Oslo, Norway. In this process, an extremely soft binder component is mixed with the aggregate in the first stage at 100-120°C (212-250°F) to fully coat the aggregate. In the second stage of production, an extremely hard binder component is then foamed into the pre-coated aggregate mixture. This combination of soft binder and foaming of the hard binder acts to lower the viscosity to provide the necessary workability. This allows the mixture to be placed and compacted at 80-90°C (175-195°F).

- The third WMA process involves the introduction of a low melting point organic additive that chemically changes the temperature-viscosity curve. The two types of organic additives used successfully to date are a synthetic paraffin wax and a low molecular weight ester compound. Both additives melt at approximately 99°C (210°F) and produce a reduction in the binder viscosity by providing excess liquid above their melting points. Blending 3 to 4 percent by weight, allows a reduction in production temperatures of 18 to 54°F. The paraffin wax is Sasobit®, a product of Sasol Wax, South Africa, a long-chained aliphatic hydrocarbon derived from coal

gasification. The ester compound is Asphaltan B®, a product of Romonta GmbH, Germany, and is a byproduct of the toluene extraction of brown coal.

Warm Mix Asphalt Paving Demonstration

In an effort to introduce the environmental and economic benefits of WMA technology to the U.S. paving industry, the organizers of the World of Asphalt 2004 Conference in Nashville, Tennessee, provided a warm mix asphalt paving demonstration. Nearly 500 people attended the three-hour demonstration that laid conventional HMA and WMA side by side. Temperature readings taken behind the screed on the two different materials showed approximately 27°C (80°F) difference.

Despite the nearly 27°C (80°F) temperature difference, the same density was achieved on both the conventional HMA mat and the WMA mat.

The Aspha-Min® process was demonstrated. The synthetic zeolite material, in the form of a fine powder, was blown into the mixing chamber of a conventional hot mix plant during production. A small self-contained metering unit was the only plant modification required to produce the WMA mix used in the demonstration.

Workability and compaction become concerns with conventional mixes as they cool down, but the WMA technology performed as predicted. Despite the nearly 27°C (80°F) temperature difference, the same density was achieved on both the conventional HMA mat and the WMA mat. Comments made by the laydown crew that the WMA seemed to be easier to handle and place are very good indicators that lower fumes and odor are not the only benefits to the workers who use WMA.

Technology of the Future?

Is warm mix asphalt the technology of the future in the asphalt

industry? This will not be an easy question to answer. Nor will it be answered in the near future. In Europe, environmental benefits appear to be the driving force behind the development of WMA. In the United States, engineering controls on asphalt plants and pavers offset some of these environmental benefits. Economic, as well as environmental, concerns must be considered. Long-term pavement performance cannot be sacrificed for a short-term economic gain.

The asphalt industry will need to do the requisite research, build the necessary demonstration projects, and do the long-term pavement evaluations to confirm the performance of WMA pavements over time. Once this is done, the full environmental and economic benefits of warm mix asphalt technology will become a valuable tool in the pavement engineer's arsenal. ▲

The laydown crew felt the WMA might be easier to handle and place than a conventional HMA.

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