

top 10 list



ONTARIO ASPHALT PAVEMENT COUNCIL



WAYS TO GET MORE DURABLE HMA PAVEMENTS

#4

DON'T OVER HEAT THE MIX

Heating-up material components of hot-mix asphalt (HMA) is critical for production. However, overheating the asphalt cement and mix will result in premature oxidation, which may lead to cracking. Chemical reaction rates typically double with each 10°C increase in temperature. If HMA plant temperatures are too high, or if HMA mix is held at a high temperature for extended periods of time (e.g. long haul to jobsite or silos without nitrogen blanket), significant oxidation will lead to brittle binders.

The following checklist outlines key facts about asphalt oxidation, and how to manage overheating concerns to ensure quality and durability of asphalt pavements.



ASPHALT OXIDATION

- Asphalt cement oxidation significantly impacts age-related pavement damage due to changes in the time-temperature dependence of the viscoelastic asphalt binder. The chemical and/or physicochemical changes that occur in asphalt due to oxidative aging increases both the viscous and elastic properties of the binder, resulting in stiffening of the material.
- Aged asphalt binder can typically sustain high shear stress due to its increased elastic stiffness, but it has reduced stress relaxation properties through viscous flow. As a result, asphalt pavements become more susceptible to cracking and other durability-related distresses.
- Overheating asphalt cement leads to high viscosity which may not completely coat the aggregate in the mixture. If the viscosity is too low, binder drainage is likely to occur during the storage and transportation of the mix. Identifying the most suitable temperature range for mixing allows decisions on the suitability of the binder to be made.
- Fundamentally, asphalt cement oxidation creates carbonyl compounds, primarily by oxidizing aromatic compounds in the naphthene aromatic, polar aromatic, and asphaltene fractions. High concentrations of asphaltenes produce a hard binder with a low penetration, high softening point, and high viscosity.



MANAGING OVERHEATING CONCERNS

- Over heating asphalt cement changes its rheological properties, thus decreasing cohesive properties required for the mix stability and impacts on optimum AC content. A stable mix is rut-resistant.
- Over heating asphalt cement decreases bulk density of mix. Voids filled with asphalt are related to the voids in total mix and density. Higher density values equal lower percentage of voids in the mixture.
- It is recommended that, targets and reasonable adjustments are specified at the start of a mix design for proper mixing and compaction temperatures, per project conditions (weather, haul distances, etc.). Where possible avoid discrepancies from the mix design temperature of more than 25 degrees. Also, when working with modified binder, the binder supplier should provide mix temperature recommendations.
- The emission of blue smoke from the mix indicates overheating. Lowering temperatures at an HMA facility is the greatest contributor to retarding blue smoke formation. Visual inspection is recommended to ensure temperature is within the proper range.
- Maintaining heat in the mix is critical to achieve density and construct a quality pavement. In order to prevent the mix from being overheated, temperatures listed in specifications are not to be exceeded.

The following measures should be considered to help maintain heat in the mix and obtain the required pavement density during early or late paving season:

- + Produce and place mixes at the upper range of the mix temperature specifications;
- + Decrease the plant production rate if necessary;
- + It is important to ensure that, there are proper protocols and procedures to monitor and record temperature of the liquid asphalt and hot mix asphalt during production to check for any potential overheating that could lead to binder and mix hardening;
- + Blue smoke formation and release can be controlled sufficiently by conforming to all applicable production and environmental codes and regulations;
- + Ensure paving equipment are at or reasonably above compaction temperatures during placement; and
- + Specifying Warm Mix Asphalt (WMA) for late season paving may help alleviate overheating concerns.

In summary, overheating asphalt can cause it to oxidize quickly. All asphalts undergo some degree of oxidation as a result of being heated at the mixing plant, but overdoing it embrittles the asphalt. This brittleness reduces the ductility in the mix, making the resulting pavement more susceptible to cracking under traffic loads. Therefore, temperature control is stressed in all phases of production and placement of hot mix asphalt.



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