FLEXIBLE PAVEMENTS OF OHIO

An Association for the development, improvement and advancement of quality Asphalt Pavement Construction.

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Technical Bulletin: **Use Of Crack Sealing Prior To Placement Of Hot Mix Asphalt**

Introduction:

Pavements constructed of Hot Mix Asphalt (HMA) have the unique features of quietness and comfort. The excellent ride quality is the result of the seamless nature of HMA pavements, allowing them to be free from abrupt bumps. In some HMA overlays, however, ride quality has been hampered by the occurrence of bumps where overbanded crack-sealing material has been encountered. This distress typically occurs when the HMA overlay is placed within a year of a crack-sealing treatment that has used the *overbanding*[1] method. The purpose of this bulletin is to provide guidance to specifiers on how best to mitigate loss in ride quality when faced with the task of overlaying a cracked-sealed, overbanded pavement.

What's The Cause?

One cause of the abrupt bump has long been speculated to be the result of the HMA sliding on the crack sealer during the compaction, or rolling, of the overlay. Another probable cause is the difference in the melting points of the two materials: the crack sealant and the asphalt binder. This would apply particularly to those crack-sealing materials having elastomeric additives. In these instances the crack sealant is found to have a higher melting point than the typical paving temperature of Hot Mix Asphalt. As the HMA "crawls" under the weight of compaction equipment, it eventually encounters a band of crack sealant that acts to restrain the crawling effect. In either case, a lack of continuity in the friction property of the existing pavement surface results in a bump created during the compaction process.

Other contributory factors exist. The width of the band and the amount of sealant are such factors. As the width of the band increases and more sealant is exposed to the paving surface, the lack of continuity in the surface friction increases, and so does the potential for distress. As the amount of sealant increases so does the potential for it to be drawn into the asphalt overlay, changing its behavior under compaction equipment. The age of the sealant plays a role by its effect on the viscosity of the sealant. Hardening of the sealant will occur over time due to oxidation. As the sealant hardens it takes on characteristics similar to the binder used in the asphalt pavement. The result is friction properties more similar to the pavement surface. This explains why paving over crack sealant that has been in service for many years rarely results in a bump. If a sealant is expansive, its volume will change when heated. This is another contributory factor. In such instances a hot asphalt overlay

[1] Overbanding is the application of crack sealant on the surface of the pavement in conjunction with sealing the crack. It is centered over the crack and is generally 3 to 5 inches wide and 1/8" to 3/16" thick.

may initiate a volume change, thereby creating a bump.

Thickness of an overlay is also a consideration and it has a dual effect. Thick overlays that hide the sealant deep down may help limit the occurrence of bumps. However, a thicker mat retains heat for a longer period of time than a thin overlay. This can cause softening of the sealant and can exacerbate the problem of creating bumps. As the sealant softens, its friction properties change. In addition, it can be drawn up into the overlay, thereby changing the volumetric properties of the overlay above the sealant.

Lastly, the direction of travel of compaction equipment can affect the severity of the bumping. The Asphalt Institute recommends compaction be accomplished with the drive, or power, wheel of the roller forward so that the roller pulls the mix under the drum instead of shoving it.

What's The Cure?

As with so many things, prevention is usually cheaper and better than correction. Assuring the avoidance of bumps in a thin overlay of a recently crack-sealed pavement is improbable. The designer should consider whether crack sealing ahead of the resurfacing is the best alternative. If the goal is to control or retard the incidence of reflective cracking, then other alternatives should be considered. An investigation by ODOT concluded that crack sealing just ahead of resurfacing was not cost effective in preventing reflection cracking. However, some agencies and vendors believe the practice is worthwhile.

Alternative treatments for controlling reflection cracking include: thicker HMA, perhaps in conjunction with milling; polymer modified HMA; fabrics and interlayers; saw and seal; and fractured slab techniques. Feasibility, cost and effectiveness should be considered in selecting a treatment.

If crack sealing is done, it should be completed a year ahead of the resurfacing; or it should be withheld and performed after reflection cracks appear in the new overlay. Either of two types of crack sealing should be used, depending upon the requirements. Use of the appropriate type sealant will yield better performance and minimize problems with the HMA resurfacing. For working cracks[2], reflection cracks in overlays over concrete, widening, or other substantial cracks, use the routing method and Type l sealant as described in Ohio Department of Transportation Supplemental Specification 825; item description – "Crack Sealing with Routing, Type l". The Type l, polymer-modified sealant is most effective in sealing working cracks and the required squeegee application prevents an excess of sealant on the pavement surface. For random cracks in flexible pavement, use SS 825; item description – "Crack Sealing, Type ll." The Type ll, fiber-modified sealant with a modest overband, or cap[3], will be reasonably stable under an overlay. For cracks wider than 1 inch, consider repair and filling with a spray patching technique using aggregate and asphalt.

Excessive crack sealing should be avoided. If the sealant quantity is greater than 5000 pounds per lane mile, other treatments such as thicker overlays, or milling, interlayers, or surface treatments in

[2] Working cracks are those that move horizontally and/or vertically 0.1 inch or more.

[3] A cap is created when a squeegee is not used and the sealant over the crack is left unshaped.

conjunction with an overlay may be more appropriate.

Inevitably, there will be occasions where paving over a recently crack-sealed pavement may be necessary. In these instances a few measures can be taken to mitigate poor ride quality in the finished product.

First, a determination of the type of sealant on the pavement should be made, noting the application temperature of the material. Next, **for single-course overlays**, milling should precede the overlay. Milling should be sufficiently deep to assure removal of the sealant from the surface of the pavement. Milling depth should be increased to remove the reservoir of sealant remaining in the crack if the application temperature of the sealant is lower than the anticipated placement temperature of the asphalt overlay. This will inhibit sealant from being drawn up into the overlay and creating a bump.

For two-course overlays, milling will be necessary if the application temperature of the sealant is lower than the placement temperature of the asphalt overlay. The milling depth should be such that it will remove all the sealant from the crack reservoir. This is necessary to inhibit the sealant from being drawn through both courses of the hot asphalt mat. Where the sealant's application temperature is greater than the placement temperature of the hot mix asphalt, milling can be avoided. Note, however, that this procedure will result in the first course of the overlay exhibiting roughness (i.e. bumps). Overlaying with a second course of asphalt will remove some of the roughness observed in the first course. For maximum smoothness, however, best practice is to mill the surface free of any sealant.

Conclusions

- Placement of thin HMA overlays over recently crack-sealed surfaces can result in bumps and a loss of ride quality.
- Crack sealing should be performed when needed, and at least one year ahead of resurfacing.
- Milling and two-course overlays are, in most cases, helpful in restoring an acceptable level of smoothness to a crack sealed pavement.
- Depth of milling should be determined according to the type of sealant, placement temperature of the asphalt overlay, and the number of courses placed.
- Alternative treatments to retard reflection cracking in a new HMA overlay should be considered.

References:

- Ohio Department of Transportation Pavement Preservation Program (draft document dated December 10, 1999)
- Crack Sealing Performance for Flexible Pavements by Reed Freedman and Dave Johnson, Proceedings of the Fifth ASCE Materials Engineering Congress (available from ASCE, 1801 Alexander Bell Drive, Reston, Virginia 20191)
- American Society of Testing and Materials, Specification D3405-97, Standard Specification for Joint Sealants, Hot Applied, for Concrete and Asphalt Pavements (available from ASTM, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959
- Ohio Department of Transportation, Supplemental Specification 825, Crack Sealing, Hot Applied, September 14, 1999
- SHRP-H-348, Manuals of Practice, Materials and Procedures for Sealing and Filling Cracks in Asphalt-Surfaced Pavements, Kelly L. Smith, Russell Romine, ERES Consultants, Inc., Savoy, IL, Strategic Highway Research Program, National Research Council (available from TRB, Box 289, Wash. DC 20055)