

FLEXIBLE PAVEMENTS OF OHIO

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

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Technical Bulletin: Smoothseal, (ODOT, Item 424, Fine Graded Polymer Asphalt Concrete) Overlays For Use As Preventive Maintenance Surface Treatments – 9Jul02 rev. 8Apr09

General

Recent emphasis on preventive maintenance (PM) has specifiers looking for pavement treatments that are durable, long lasting, able to be placed in thin layers, and won't bust the bank. A treatment catching the eye of specifiers is smoothseal (ODOT, Supplemental Specification 854). A hot mix asphalt treatment designed specifically for thin lift ($\frac{5}{8}$ -inch – $\frac{3}{4}$ -inch) placement, smoothseal was developed for structurally sound pavements that are showing signs of aging, oxidation or minor surface disintegration.

Twenty-eight years is how long smoothseal, Type A, has lasted on Ohio's roadways and streets – and the clock continues to tick. Winner of the 2001 Flexible Pavements of Ohio Master Craftsman Award, Shelburne Road in the City of Shaker Heights used smoothseal in 1973 as a pavement surface. The City was looking for a durable, long lasting surface. Durable and long lasting, smoothseal has proven itself to be. Characteristic of many established communities, the City of Shaker Heights enjoys the grandness of towering trees and architectural beauty amongst its winding roadways. With such grandness comes the need for pavements that provide long term durability. Oftentimes the beauty of tree canopy can cause a pavement to deteriorate more quickly by allowing moisture to remain on the pavement surface. Long term exposure to moisture can lead to surface distress in some asphalt mixes. Smoothseal's ability to combat such destructive forces is what makes it a long-term preventive maintenance fix.

Thin overlays, both of conventional materials and polymer modified sand asphalt, have commonly been used as preventive maintenance

surface treatments. These overlays can cost effectively protect and preserve the underlying pavement structure in the same manner as other surface treatments, and with additional advantages.

Advantages of an asphalt overlay used as a preventive maintenance treatment are:

- Longer life with attendant lower annualized cost (i.e. better cost effectiveness)
- Smoother, providing a higher level of user serviceability (i.e. comfort) than other treatments
- Increased pavement strength and load carrying ability

The reason for smoothseal gaining acceptance is very simple - it provides the opportunity for extended pavement surface life at a cost that is affordable. When smoothseal is specified, the driving public receives the additional benefit of a smooth and quiet ride that is typical of asphalt pavements. Also, annualized costs indicate that hot mix asphalt treatments used as preventive maintenance strategies are the most cost-effective treatments.

Description of Candidate Projects

Pavements suitable for a surface treatment overlay show the following distresses:

- Dry-looking, "bony" pavements that are porous or permeable
- Pavements that have begun to ravel
- Pavements with extensive cracking too fine for crack sealing
- Pavements with cracking of the surface too extensive for crack sealing alone

Suitable candidate projects will have no unrepaired structural (fatigue) damage and will have sufficient remaining structural capacity to last the expected life of the preventive maintenance treatment. Rapidly deteriorating projects are not good candidates for preventive maintenance as the rapidly declining condition may be indicative of structural inadequacy. Smoothseal should be used wherever pavement preservation is the objective of a treatment. It should be placed on structurally sound pavements that are exhibiting only surface distress. Raveling and minor cracking due to oxidation are the types of distresses for which smoothseal is ideally suited.

If significant rutting exists ($> \frac{1}{4}$ inch) in a candidate pavement, the cause must be determined and corrected. Pavement layers exhibiting plastic deformation must be removed and replaced with materials having sufficient stability to resist the stress being applied. Structural or base deformation is an indicator of the need for a structural overlay (i.e. thick overlay) or pavement reconstruction. See Appendix B of the ODOT, Pavement Design and Rehabilitation Manual, or Flexible Pavements of Ohio's, Asphalt Pavement Design and Construction Guide, Section 4.4, for guidance in dealing with high stress conditions.

Materials Characterization

There are two types of smoothseal – Type A and Type B. The difference between the two is seen primarily in particle size and asphalt binder content. Type A, formerly specified as ODOT Supplemental Specification 805, is a blend of asphalt sand and mason sand, with an 8½ percent asphalt binder content. Type B is a blend of ½-inch maximum sized coarse aggregate and sand size particles with a minimum asphalt binder content of 6.4 percent. A silicon dioxide requirement for both mix types ensures good friction characteristics. Smoothseal, Type B, is unique in that, for heavy traffic conditions, it uses 100 percent two-faced crushed coarse aggregate. The crushed aggregate acts to provide internal friction to the mix, leading to greater stability. Complimenting the mixture's stability is the use of SBR latex rubber polymer, or PG 76-22M – SBS polymer-modified asphalt binder. The synergy of using crushed aggregate and a polymer-modified binder results in toughness and tenacity superior to conventional fine-graded hot mix asphalt.

Smoothseal, ODOT Item 424 (Fine Graded Polymer Asphalt Concrete), Type A is a recipe mix. The contractor determines the proportions of aggregates such that when they are combined the

final gradation meets the requirement specified in Item 424. The asphalt binder content is predetermined to be 8½ percent of the mix. Type B mixes, on the other hand, are designed mixes - according to the Marshall Method. Type B mixes can be designed for light, medium or heavy traffic per specification 441 of the ODOT Construction & Materials Specification book (C&MS). This material has a dense gradation and the specification requirements for manufacturing the material uses a very narrow gradation band. The narrow band helps ensure consistent mix performance. High silicon dioxide content natural sand is used for excellent skid resistance.

For enhanced durability and stability in the preventive maintenance application the use of polymer-modified binders should be emphasized. Experience has shown that polymer-modified asphalt is effective in extending the life of an asphalt surface - which is the goal of preventive maintenance. There is considerable experience to suggest that polymer-modified surfaces will average 12 years of life, and possibly more on structurally sound pavements, and that the extra cost is justified based on this enhanced durability. Additionally, highly polymer-modified mixes such as smoothseal benefit from increased stability. This enhanced stability increases resistance to rutting and shoving. Smoothseal, both Types A and B, use binders equaling or exceeding a PG 76-22M. The specification, Item 424, by default requires a high level of SBR or SBS polymer modification of the binder. No additional binder designation is required when specifying item 424, Type A or B mixes.

Description of Application

A smoothseal overlay will generally consist of a single course overlay 1½-inch thick or less. Application thickness should be appropriate for the surface conditions and mix specified. That is, sufficient thickness must be specified to permit placement and compaction of the overlay over the existing pavement irregularities without exceeding the material's minimum or maximum layer thickness. Uniform courses are best for optimum compaction. Sufficient course thickness must be placed to ensure at least 1½ times the largest aggregate particle size over high spots, and not more than 3 times in the low spots. For Item 424, Type A, this means using a course thickness that is a minimum of $\frac{5}{8}$ -inch to a maximum of $1\frac{1}{8}$ -inch. For the Type B mix, course thickness of $\frac{3}{4}$ to $1\frac{1}{2}$ -inch should be used. Pavement surfaces having greater variation will require planing (ODOT Item 254) or a leveling course prior to placement of smoothseal.

The mix specified must be appropriate for the traffic conditions to which it will be subjected, that is, light, medium, heavy or high stress. Item 424, Fine Graded Polymer Asphalt Concrete, Type A is suitable for medium traffic and urban applications and Type B, designed per ODOT Item 441 for light, medium or heavy traffic, may be specified for any and all applications, including heavy duty and high speed applications.

The preventive maintenance concept does not necessarily preclude the use of pavement planing or a leveling course, which can provide the advantages of a smoother ride, achieving greater density in a uniform thickness, or being able to maintain curb exposure, etc. If a leveling course is desired, a scratch course of conventional Item 448, Type 1 material may be specified.

Quality Control Issues

Production of all hot mix asphalt mixtures is, by existing specification requirements, subject to the most rigorous quality control and quality assurance procedures. The Ohio Department of Transportation reviews and approves the contractors' mix designs, quality control plans and test result reports and final acceptance testing. For item 424, Fine Graded Polymer Asphalt Concrete, Type A is not a designed mix and is accepted under Specification Item 403, Bituminous Concrete Quality Control & Acceptance, using the procedure for Item 301. Type B is accepted under Item 403 per 448 procedures.

Manufacturing and Placement

Manufacturing smoothseal will be similar to any hot mix asphalt mixture using polymers in the asphalt binder. In general, polymer-modified mixes will require greater heat during production. A result of this is that mixtures will arrive at the project site at elevated temperatures - when compared to conventional mixes. ODOT, in its specification Item 702, sets the maximum temperature for polymer modified mixes at 350 degrees F. Of primary importance is that the mix temperature should be high enough such that when it is delivered to the project site it has sufficient heat to facilitate compaction. Mix temperature should not be so excessive as to cause the binder to drain off the aggregate during placement or while the mix is in transit. ODOT specifications, Item 401.16, require polymer-modified mixes to be not less than 290 degrees F just before rolling. Item 424, Type B has been successfully placed under Warm Mix Asphalt

(WMA) production procedures at temperatures 30 degrees lower than normal for both production and placement.

Paver operation differs from conventional mix methods when smoothseal is being placed only in that the use of polymers requires increased attention to factors affecting pavement smoothness. Obtaining high quality, smooth asphalt paving projects requires the contractor to be sensitive to all matters affecting mix manufacturing, placement and compaction. With polymer-modified mixes sensitivity to these factors is heightened. Uniform mix production, uniform mix temperature, uniform delivery of material to the project, uniform head of material in front of the screed, and uniform compaction, all become critically important.

Handling and raking should be minimized when smoothseal, or any other polymer-modified mix is placed. The high binder and polymer content of smoothseal causes it to be very, very sticky. Handwork is not easily accomplished and may harm the aesthetic qualities of the mat. The same sticky that causes handling difficulty also may cause accumulation of material in delivery truck beds. However, it is this same material quality that provides the extended pavement life desired in a preventive maintenance treatment.

Butt joints are preferred for joint construction. Keep handwork and feathering areas off public road traveled surfaces, especially for polymer modified materials that are more difficult to hand work. Consideration should be given to allow conventional medium traffic mix to be used for drives and approaches requiring handwork or feathering.

The specification requirements of Item 401 of the ODOT C&MS apply to the construction of a smoothseal project except where modified by Item 424. Ensuring a successful project will require attention to the following:

- The existing pavement surface must be clean and dry prior to placement of smoothseal.
- Weather limitations for smoothseal are stricter than conventional hot mix asphalt. Minimum pavement surface and air temperatures of not less than 60 degrees F are required prior to mix placement (note: allowable time for compaction at 60 degrees F for a 1-inch course thickness is only 10 minutes).
- A uniform application of tack coat, set prior to paving, is necessary to promote bond with the existing pavement.
- Material is placed with conventional asphalt pavers.

- Compaction of the mix must conform to the requirements of Items 401.13 and 401.16.
- The number and types of rollers are governed by Items 401.13 and 401.16. No vibratory rollers are permitted for use if the course thickness is $1\frac{1}{2}$-inch. Vibratory rollers used on thin lifts cause aggregate degradation due to the impact force of the rolls. **DO NOT USE PNEUMATIC TIRE (RUBBER TIRE) ROLLERS.** Polymers in the smoothseal mixture will react with the rubber of a pneumatic tire roller and result in the rolls picking up the mix.
- Construct hot longitudinal joints or seal cold joints with bituminous material. Treat the joint using a rate that will thoroughly coat the vertical face without running off.

Specifications, Pay items, Costs

Specifying smoothseal was made easier when the Ohio Department of Transportation added the specification outlining its material requirements to their 2005 Construction and Materials Specifications (CMS) book as Item 424, Fine Graded Polymer Asphalt Concrete.

When specifying smoothseal, Type B, the pay item must include the traffic type (i.e. light, medium, or heavy). This is due to the fact that the Type B material's design is based upon criteria governed by the Marshall Method of asphalt mixture design. The Item 424 specification automatically designates the asphalt binder type for both Type A and B mixes – eliminating the

need for this information in the pay item description.

“Your cost may vary.” Costs for smoothseal will vary based upon quantity, location and other factors. Costs could vary from 20 to 40% more per cubic yard than conventional, non-polymer modified materials.

Maintenance of Traffic Considerations

Follow the conventional practices for hot mix asphalt overlays. Overlays may be placed with traffic maintained with flagman control for 2-way facilities or with temporary lane closures on multi-lane facilities. Overlays may be placed at night when weather conditions permit satisfactory compaction. Light vehicular traffic may be allowed to cross a newly placed overlay for maintenance of access, but normal traffic should be kept off the overlay until it has cooled below 150 degrees F to avoid deformation or glazing under traffic.

Conclusion

Smoothseal is a highly durable HMA surface mixture that is ideally suited to thin preventive maintenance applications less than one-inch thick. However, smoothseal may also be used as a long lasting surface course in rehabilitation or new construction pavement build-ups as well.



All reasonable care has been taken in preparation of this Bulletin. However, Flexible Pavements of Ohio can accept no responsibility for the consequence of any inaccuracy that it may contain.

References:

- Asphalt Pavement Design & Construction Guide, February 1, 2000, Flexible Pavements of Ohio
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- Pavement Design Manual, July, 2008, Ohio Department of Transportation