TECHNICAL BULLETIN

OPEN GRADED COLD MIXES

PROCESS DESIGN OVERVIEW

1 SCOPE

Advances in asphalt emulsion technology make it possible for emulsion mixes to be used in a wide variety of pavement construction, rehabilitation, and maintenance applications. These mixes can be used as base and surface courses, stockpile mixes, upgrading gravel roads, and helping to reduce the total pavement thickness. One of these mixes is the open graded type which consists of a virgin coarse aggregate and an asphalt emulsion. These mixes can be produced in a central plant or in a travel plant. The emulsion should be designed for the mixing process to be used.

1.1 DEFINITIONS

Open Graded Mix:

An Open Graded Mix is a coarse aggregate mix (very little fines) with high air voids to allow for water to drain through them. These mixes can be used as a base or surface course. They show good resistance to fatigue, reflection cracking, rutting and shoving. These open graded mixes normally do not require a thin lift surfacing to be placed over them.

2 MATERIALS

2.1 Asphalt Emulsions:

The asphalt emulsion grade used in open graded mixes is the medium setting types containing a small quantity of solvent. The use of solvent helps the mixture to flow evenly through the paver screed and provides the mix with flexibility. The proper emulsion to be used is based on a number of factors; environmental conditions (temperature and humidity), traffic volume and type, type of cover aggregate and the existing road surface conditions (slope, shade, hills and curves). All these conditions affect the emulsion to be used. Typically the most common emulsions used are CMS-2, CMS-2h, MS-2, MS-2h as well as proprietary emulsions.

2.2 Mix Aggregate:

The type of mix aggregate used in open graded mixes must meet certain requirements of shape, size, cleanliness and surface properties. The aggregate should have a maximum size of 25.0 mm for base courses, 12.5 mm for surface courses and have between 0 and 10% passing the 4.75 mm sieve size as well as having no more than 2% passing the 75 micron sieve size. The number of flat and elongated particles should be kept to a minimum so that the proper quantity of asphalt emulsion can be applied to hold the aggregate in place. The % crushed faces should be a minimum of 65% two faces and 90% one faced. Also the asphalt emulsion to be used and the coarse aggregate must be compatible to ensure the asphalt-aggregate bond is effective.

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3 DESIGN CRITERIA

When designing an open graded mix a number of factors have to be examined and assessed to ensure a proper surface will be placed that will perform for its service life. The following factors can have a tremendous effect on the performance of an open graded mix; aggregate shape, specific gravity of the aggregate, aggregate type, residual asphalt content. If these factors are addressed the chances of a good open graded mix being placed are greatly increased.

Aggregate Shape and Type:

The overall shape of the mix aggregate can influence the quantity of aggregate as well as the amount of asphalt emulsion to be used. The larger the aggregate size the lower the emulsion quantity needed. The gradation can also influence the quantity needed.

Specific Gravity of Mix Aggregate:

The bulk specific gravity of the mix aggregate will affect the quantity of aggregate needed. The higher the specific gravity the more aggregate is needed and vice versa.

Asphalt Residual in the Emulsion:

The quantity of asphalt residual in the emulsion can affect the quantity of emulsion needed to hold the cover aggregate. The lower the residual the higher the quantity of asphalt emulsion needed. The more viscous the emulsion is the better the mix. Open graded mixes require a thick film of asphalt to provide greater durability.

There are basically two key tests that need to be performed when designing an open graded mix; emulsion/aggregate compatibility and runoff test. The emulsion being used has to be compatible with the aggregate to ensure that a good bond will develop between the residual asphalt and the coarse aggregate. The runoff test determines the optimum emulsion content to be used and will give the mix sufficient workability and coating.

If these factors are taken into consideration in designing the open graded mix then the chances of a successful mix are greatly improved. Typically a open graded mix would require an emulsion content of 5.0 – 7.0%.

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4 RECOMMENDED PERFORMANCE GUIDELINES

In order to construct a proper well designed open graded mix the following guidelines should be followed:

- Assure the existing pavement structure is adequate to support expected traffic.
- Design a open graded mix with aggregate to be used on job.
- Use a clean hard crushed coarse aggregate having very low fines.
- Ensure asphalt emulsion and aggregate are compatible.
- Ensure adequate emulsion is used.
- Ensure aggregate is moist but not saturated.
- Calibrate and inspect all equipment.
- Use sufficient number and properly weighted steel rollers in static mode.
- The use of blotter or choke sand is recommended to prevent pick-up.
- Follow proper construction techniques.
- Use traffic control to protect mix.
- Work only in weather suitable for type and grade of emulsion being used.

5 RESOURCES

1. “Basic Asphalt Emulsion Manual”, Fourth Edition, Asphalt Institute and Asphalt Emulsion Manufacturers Association, 2008
2. “Recommended Performance Guidelines”, Second Edition, Asphalt Emulsion Manufacturers Association, Annapolis Maryland, 2006