

OPEN GRADED COLD MIXES

GENERAL INFORMATION AND RESOURCES

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, upgrades for gravel roads, and as a means to reduce the total pavement thickness. One such mix is known as an open graded cold mix, consisting of a virgin graded aggregate and an asphalt emulsion. These mixes can be produced in a central plant, in a travel plant, or by using a pugmill.

DEFINITIONS

OPEN GRADED COLD MIX

An open graded cold mix is a coarse aggregate mix (very small amount of fine aggregate) with a large amount of air voids to allow for water to drain. These mixes can be used as a base or surface course and show excellent resistance to fatigue, reflection cracking, rutting, and shoving. Open graded mixes do not always require a thin lift of surfacing to cover them.

MATERIALS

ASPHALT EMULSIONS

A medium-setting emulsion containing a small quantity of solvent is used in open graded cold mixes. The use of solvent provides the mix with flexibility and helps the mixture flow evenly through the paver screed. The type and grade of emulsion to be used is based on a number of factors: environmental conditions (temperature and humidity), the type and volume of traffic, the type of cover aggregate, and the existing road surface's physical characteristics such as slopes, shade, hills, and curves. Typically, the most common emulsions used are CMS-2, CMS-2h, MS-2, and MS-2h, as well as proprietary emulsions. Alternatively, gelled and fluxed asphalts can be used for open graded cold mixes.

COLD MIX AGGREGATE

The type of mix aggregate used in open graded cold mixes must meet certain requirements for shape, size, cleanliness, and surface properties. The aggregate should have a maximum size of 25.0 mm for base courses and 12.5 mm for surface courses. It must also have between 0 and 10% passing the 4.75 mm sieve with no more than 2% passing the 75 µm sieve. 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 aggregate should be a minimum of 65% two-faced fractures and 90% one-faced fractures. Additionally, the asphalt emulsion and the coarse aggregate must be compatible to ensure a strong bond between the asphalt and the aggregate.

DESIGN CRITERIA

When designing an open graded cold mix, a number of factors have to be examined and assessed to ensure a high-quality pavement surface: aggregate shape, specific gravity of the aggregate, aggregate type, and residual asphalt content.

AGGREGATE SHAPE AND TYPE

The overall shape of the mix aggregate used in an open graded cold mix can influence the quantity of aggregate and asphalt emulsion required for an effective mix. With larger aggregate sizes, less emulsion is needed and vice versa. The gradation of the aggregate can also influence the quantity of both the aggregate and the emulsion required.



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SPECIFIC GRAVITY OF MIX AGGREGATE

The bulk specific gravity of the mix aggregate will affect the quantity of aggregate required to make an effective product. Aggregate with a higher specific gravity requires a higher volume of aggregate and vice versa.

ASPHALT RESIDUE IN THE EMULSION

The quantity of asphalt residue in the emulsion used in an open graded cold mix can affect the quantity of emulsion needed to hold the cover aggregate. With a lower asphalt residue, more asphalt emulsion is required to achieve the same effect. Also, the more viscous the emulsion is, the better the mix because open graded cold mixes require a thick film of asphalt in order to provide greater durability.

There are two key tests that need to be performed when designing an open graded cold mix: emulsion/aggregate compatibility and runoff. The emulsion being used must be compatible with the aggregate being used to ensure that a good bond will develop between the residual asphalt and the coarse aggregate. The runoff test determines the ideal emulsion content required to give the mix sufficient workability and aggregate-coating properties. An open graded cold mix would typically require an emulsion content of 5.0 to 7.0%.

RECOMMENDED PERFORMANCE GUIDELINES

In order to construct a well-designed, high-quality open graded cold mix, the following guidelines should be followed:

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

RESOURCES AND REFERENCES

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
3. "Asphalt Cold Mix Manual", MS-14, Asphalt Institute, Lexington Kentucky, 1997



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