

DENSE GRADED SEAL COATS

GENERAL INFORMATION AND RESOURCES

SCOPE

A dense graded seal coat (known simply as “dense graded seal”) is used as an economical pavement surface maintenance treatment. A dense graded seal coat can be placed on an existing road that is starting to show some distresses or it can be applied directly to a granular base without the need to prime the surface first. Dense graded seal coats are ideally suited for areas where gravel aggregates are located and traffic volumes are too low to justify using expensive washed stone in a chip seal. These types of seals are known in Europe as Otta seals.

DEFINITIONS

SINGLE DENSE GRADED SEAL

A single dense graded seal consists of one application of asphalt emulsion on an existing road surface or gravel surface followed by an application of a graded cover aggregate. The surface is then rolled to embed the aggregate. Dense graded seals can be placed in single or multiple lifts depending on the traffic demands and the condition of the existing surface.

MULTIPLE DENSE GRADED SEAL

Multiple dense graded seals can provide a more durable wearing surface than a single seal. Typically, multiple dense graded seals consist of two or more lifts of asphalt emulsion and cover aggregate. The cover aggregate for each succeeding layer can be the same size as the previous layer or a smaller size of graded aggregate, if available.

MATERIALS

ASPHALT EMULSIONS

Medium-setting, high-float emulsions containing a small quantity of fuel or solvent are used in dense graded seals. The addition of solvent helps the asphalt penetrate through the fine particles, creating a strong bond between the emulsion residue and the aggregate. The most effective grade of emulsion for each individual job is based on a number of factors: environmental conditions (temperature and humidity), traffic type and volume, type of cover aggregate, and the existing road surface’s physical characteristics such as slopes, shade, hills, and curves. The most common grades of emulsion used are HF-150, HF-150P, HF-250, and HF-250P.

COVER AGGREGATE

The cover aggregate used in dense graded seals must meet certain requirements for shape, size, cleanliness, and surface properties. The aggregate should have a maximum size of 16.0 mm and have between 45 and 65% passing the 4.75 mm sieve while no more than 7% passes the 75 µm sieve. The number of flat and elongated particles should be kept to a minimum so that the required amount of asphalt emulsion can be applied to hold the aggregate in place. The asphalt emulsion to be used and the aggregate must also be compatible to ensure the asphalt-aggregate bond is effective.

In recent developments, fractionated RAP, in combination with aggregate or by itself, can be used in the construction of dense graded seal coats.

DESIGN CRITERIA

When designing a dense graded seal, a number of factors have to be examined and assessed to ensure a high quality product: traffic, aggregate shape, specific gravity of the aggregate, aggregate wastage, and residual asphalt content.



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TRAFFIC

The type and volume of expected traffic will have a large effect on the type and amount of asphalt emulsion required for the dense graded seal coat. As the volume of traffic lowers, softer grades of high-float emulsion can be used.

AGGREGATE SHAPE

The overall shape of the cover aggregate can influence the quantity of aggregate as well as the amount of asphalt emulsion to be used. More emulsion is required for larger aggregates whereas less emulsion can be used as the aggregate size diminishes. The gradation of the aggregate can also influence the spray rate needed.

SPECIFIC GRAVITY OF COVER AGGREGATE

The bulk specific gravity of the cover aggregate will affect the quantity of aggregate required for a dense graded seal. More aggregate is required as the specific gravity of the aggregate rises and vice versa.

AGGREGATE WASTAGE

In all dense graded seals, an excess of cover aggregate has to be applied to offset the unevenness of spread and whip-off as a result of traffic. Depending on the chip spreader equipment, the excess amount can vary from 2 to 10% but is typically 5%.

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. Emulsions with a lower residual asphalt content requires the use of more emulsion and vice versa. A dense graded seal typically requires an emulsion application rate of 1.5 to 1.8 L/m² and a cover aggregate quantity of 16 to 22 kg/m².

RECOMMENDED PERFORMANCE GUIDELINES

In order to construct a well-designed, high-quality dense graded seal coating, the following guidelines should be followed:

- Ensure that the existing pavement structure is adequate for supporting the expected traffic.
- Design a dense graded seal with the aggregate to be used on job.
- Use a correctly graded aggregate.
- Calibrate and inspect all equipment.
- Use a sufficient number of properly weighted rollers.
- Correctly execute all required construction techniques.
- Use traffic control to protect the seal.
- Work only in weather suitable for 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



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