Otta Seal – Thin Bituminous Surfacing Option for Aggregate Roads

This summary is based on work performed by Greg Johnson and John Pantelis of Mn/DOT.

An Otta seal is an asphalt surface treatment constructed by placing a graded aggregate on top of a thick application of relatively soft bituminous binding agent. Minnesota has used emulsified asphalt exclusively (HFMS-2s). The binder works its way into the aggregate with rolling and traffic. In comparison to other surface treatments, material and construction specifications are not as strict. Local aggregates that would not meet the requirements for high quality paving aggregate are often used in Otta seals.

Traffic: Very Low to High (AADT < 2000) for a double Otta seal. Because Otta seals can provide a high-quality road surfacing, there is a tendency for higher road usage and speeding that may be beyond the geometrics of the existing roadway.

Base/Subbase Requirements: Otta seals do not add structural capacity to the roadway. They are constructed over an aggregate base course. The base/subbase must be designed to support the anticipated traffic loading. Subgrade and base materials should be compacted and graded to provide a stable working surface prior to Otta seal placement. A prime coat is usually not used above the aggregate base prior to Otta seal application.

Construction
Materials: An Otta seal is constructed of a graded aggregate on top of a thick...
application of relatively soft bituminous binding agent; typically emulsified asphalt (e.g. HFMS-2s). Bituminous binder application rates vary from about 0.5 ± 0.05 gal/yd² (2.2 ± 0.2 liter/m²) for emulsified asphalt, depending on aggregate gradation and type. In comparison to other surface treatments, material and construction specifications are not as strict. Local aggregate materials are often used in Otta seals. Natural gravels are acceptable. The maximum aggregate size in the graded aggregate is generally 0.50 to 1 in. (13 to 25 mm). The graded aggregate can be crushed or uncrushed and contain up to 10% fines. Quantities of aggregate are usually around 50 lb/yd². Otta seal design is empirical in nature and trial sections are recommended to determine the appropriate material application rates.

**Equipment:** The required equipment includes: asphalt distributor, chip spreader, pneumatic-tired roller, and mechanical broom.

**Placement Process:** The bituminous binding agent is sprayed onto the prepared working surface by the distributor; then, the graded aggregate is spread onto the surface using an aggregate spreader. After the aggregate is placed, the surface is rolled with a pneumatic-tired roller to embed, realign the aggregate chips in the binder, and begin drawing the binder through the aggregate to the surface. Due to the fines in the aggregate, two or three days of compaction (construction rollers followed by traffic) is required for the binder to coat all the aggregate particles. During the first few weeks, aggregates dislodged from the surfacing by traffic should be swept back into the wheelpaths. After about three weeks, the surface should be swept by a mechanical broom to remove all loose aggregate from the surfacing.

The second layer of a double seal is constructed in a similar manner. With attention to details a second application can be applied 1 day after the first application. However, it is recommended to allow traffic to knead the surface for a number of weeks.

**Lane Closure Requirements:** The roadway lane being constructed is closed during construction, so adequate traffic control is needed. The Otta seal surface can be opened to traffic as soon as it is constructed.

**Performance Expectations**
Otta seals were developed in Norway in the 1960s. They have been used in Nordic countries and developing nations. Otta seal performance has been good where a familiarity exists with chip seal technology and the empirical nature of the design.

**Life Expectancy:** Service life varies depending on construction materials, environmental conditions, and traffic volumes. Reported serviceable lives for double Otta seals range from 8 to 15 years.

**Ride Quality:** Otta seals can provide minor improvements to ride quality, but will not mitigate significant defects (rutting, depressions, etc.) in the application surface. On a proper prepared application surface, a good ride quality can be achieved after construction. Ride quality deteriorates over the serviceable life.

**Ability to Recycle/Reuse:** Otta seals can be pulverized and reused as an unbound or stabilized material.

**Appearance:** Immediately after placement, the Otta seal’s appearance is similar to a gravel road and is influenced by the aggregate color. With time and traffic, the black bituminous binding agent works its way up through the aggregate, creating a
surface appearance similar to cold mix asphalt concrete.

**Performance in Minnesota**

Otta seal has been used for roads administered by various agencies in Minnesota, and performance history exists for several years of service.

**Cass CR168** was in good condition after 7 years. Aggregate maximum size was 1-in., and the surface had no fine aggregate. Thermal cracks had occurred at intervals of 50 ft.

**Unmarked road** northeast of CR168 was generally in fair condition after 7 years. Pothole distress had developed in the centerline, and some had been repaired. Some wheelpath distress was also noted. Higher volume intersections with turning traffic had been upgraded to HMA sections.

**Cass CR171** was in good condition after 7 years and was treated with chip seal. Longitudinal cracks were evident along swampy areas.

**Cass CR25** was in good condition after 7 years and was treated with chip seal. Heavy vehicle loads are generated from a large dairy farm along the section. One intersection was replaced with HMA due to a surface shoving problem.

**Cass CR116 & 117** were in good condition after 7 years and were treated with chip seal. Intersections with turning or crossing farm equipment looked in good shape.

**MN74** in Whitewater State Park was in fair condition after 7 years. The project had received a maintenance chip seal at year 2, and performed satisfactorily until isolated areas received flood damage at year 6. Maintenance crews were repairing the damage at the time of review. Minor cases of longitudinal and transverse cracking were noted at other points along the project.

**Goodhue CR58** was in excellent condition after 3 years. The road had been chip sealed during the prior year. Two unsealed and six rout-and-sealed and transverse cracks were visible.

**Wabasha CR73** was in fair condition after 2 years. The impact of heavy vehicle loads from construction in a nearby housing development was evident. Approximately 7% of the road received full-width bituminous patching. Several transverse cracks were noted along with fatigue cracking at the center of lanes near subdivision entrances.

**90th St. N.** in Stillwater Township was in good condition after one year. The road had not been bladed or swept at the time of review. Several small potholes were filled and a park entrance was patched with HMA. The entrance also developed a crack perpendicular to the direction of traffic. The asphalt binder was found to retain some softness at this time.

**Select Resources**


**For More Information:**

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