When a road surface is adequately compacted, Otta seal provides a dense, durable, and cost-effective surface treatment for low-volume Iowa roads.

RESEARCH SOLUTIONS

Otta seal surfacing supports cost-effective, sustainable roads

Iowa DOT and county engineers need cost-effective and sustainable methods to maintain about 90,000 miles of secondary roads in the state. In a second phase of research, investigators demonstrated successful implementation of a surfacing method using locally available aggregate and developed construction specifications to guide its use on Iowa roads. Otta seal holds promise as a low-cost solution for durable, high-performing road surfaces.

THE NEED

Iowa counties spend more than $110 million annually replacing aggregate on unpaved secondary roads. While these roads generally service lower volumes of traffic, they often need to accommodate heavy farm equipment.

Iowa DOT and county engineers continually seek cost-effective and sustainable methods to keep this road network in good condition.

Otta seal, a bituminous road surface treatment technology, was incorporated into an Iowa road in 2017 after Phase I of this research. Since then, more than 50 road projects have used the low-cost resurfacing method on lower-volume roads.

The method employs graded aggregate to form a highly dense and compactable surface that reduces water penetration and withstands heavy loads.

Current Otta seal design guidelines are based on empirical evidence from Norway, where the method was developed. Iowa DOT launched a Phase II study to explore a scientifically grounded approach to Otta seal that would optimize local materials and accommodate local conditions.

RESEARCH APPROACH

Researchers first assessed 12 roads constructed with Otta seal between 2018 and 2021. An assessment of the various aggregate and binder types and application rates used at these sites along with measurements of stiffness, roughness, surface friction, and dust generation indicated surface treatment performance over several years.

(continued)

"This research shows Otta seal is like a turbocharged conventional chip seal — a cost-effective maintenance tool to support sustainable roads in Iowa conditions."

— **LEE BJERKE,**
Iowa County Secondary Roads Research Engineer

Laboratory experiments compared three design methods to investigate aggregate and binder application rates: the empirically based Otta seal design, a standard chip seal design, and a modified chip seal design. Performance differences were identified by characterizing local aggregate materials, including limestone, river rock, slag aggregate, and recycled concrete aggregate, and conducting sweep tests to assess aggregate loss on specimens developed for the three methods.

In the field, investigators used two of the Otta seal design approaches to construct three road test sections. Measures of dust and loose aggregate, roughness, and skid resistance indicated differences in performance. An economic analysis of using Otta seal on the test sections included initial construction costs, estimations of maintenance and preservation costs over the pavement's life cycle, and end-of-life strategies.

WHAT IOWA LEARNED

Otta seal performed well and at a lower cost than conventional methods, indicating its promise as a surfacing technique for gravel and asphalt roads. Over three years of monitoring, road segments previously constructed with Otta seal demonstrated good performance when sufficient compaction and other specifications were followed. The laboratory investigations confirmed the superiority of the modified design method for Otta seal, including aggregate-binder ratios and application rates, which provided the basis for construction specifications.

Testing and observing test sections illustrated the superior performance of Otta seal surfacing when the base layer was well prepared and the surface was adequately compacted. Segments constructed according to the modified design method showed the lowest roughness values and the least loose aggregate.

The economic analysis found that using the reduced aggregate and asphalt binder in the modified design method resulted in cost savings throughout the test section life cycle.

PUTTING IT TO WORK

Iowa DOT and county engineers can use the Otta seal design specifications to maintain low-volume roads after ensuring sufficient compaction and an adequate supporting base. While the research was focused on unpaved roads, the method can also support rehabilitating deteriorated pavements.

The agency may consider further research to explore the suitability of additional locally available aggregates, including recycled material, and continue long-term monitoring of roads surfaced with Otta seal. Also, preservation and maintenance strategies could be assessed and collected in comprehensive guidelines.

ABOUT THIS PROJECT

PROJECT NAME: Evaluation of Otta Seal Surfacing for Low-Volume Roads in Iowa — Phase II
Final Report | Technical Brief

PROJECT NUMBER: TR-753

REPORT DATE: December 2023

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