2015-04TS
Published February 2015

Blending Fines into Existing Loose Gravel Costs Less Than Regraveling

LRRB
LOCAL
ROAD RESEARCH
BOARD

TECHNICAL SUMMARY

Technical Liaison:
Bruce Hasbargen, Beltrami County
Bruce.Hasbargen@co.beltrami.mn.us

Project Coordinator:
Dan Warzala, MnDOT
Dan.Warzala@state.mn.us

Principal Investigator:
Charles Jahren, Iowa State University

LRRB PROJECT COST:
$88,910

Olmsted County's experimental sections performed satisfactorily in follow-up visits.

Researchers tested a process to inexpensively rejuvenate gravel roads by blending crusher dust into floating aggregate already on the road. The process can be successful if low-cost crusher dust with adequate plasticity is available.

What Was the Need?

Gravel roads can develop problems due to floating aggregate, an excess of large rocks left on the surface of the road when rainfall, vehicle traffic or maintenance operations erode the fine particles binding the gravel together. This can lead to rutting, potholes, reduced road comfort and safety, ridges that channel water, and road distress or failure.

Local agencies have generally addressed the problem of floating aggregate by simply regraveling a road with an appropriate mix of new gravel and silt or clay fines. However, some parts of Minnesota have limited sources of aggregate, and extracting and hauling it to the road site are becoming more expensive.

To reduce costs, the Local Road Research Board wanted to consider mixing fines into existing aggregate on a road as an alternative to regraveling.

What Was Our Goal?

The goal of this project was to assess the effectiveness and economic feasibility of a proposed method for rejuvenating aggregate road surfaces by adding fines and mixing them into the road surface rather than regraveling the road.

What Did We Do?

Researchers tested variations of the procedure at three sites: County Road 76 in Jackson County, CR 23 in Beltrami County and CR 115 in Olmsted County.

In Jackson County, researchers windrowed loose aggregate at the centerline of the road, spread crusher dust on top of it and blended the two by blading it twice with a motor grader. The site had three 500-foot sections: a control section that received 19 tons of Class 5 aggregate and experimental sections that received seven or 12 tons of crusher dust from crushed stone.

In Beltrami County, they windrowed the top inch of aggregate on the side of the road, spread additional crusher dust at the center and bladed each side of the road twice to blend. The site had three 1/3-mile sections: a control section that received 166 tons of Class 1 aggregate and test sections that received 50 or 83 tons of crusher dust derived from granite.

In Olmsted County, the test site had four sections, each approximately 1,000 feet long. One section used 235 tons of Class 5 aggregate; another section used 251 tons of a mix of two parts Class 5 aggregate and one part lime; a third section used 243 tons of half Class 5 aggregate and half Class 2 aggregate; and the fourth section used 270 tons of Class 2 aggregate.

Researchers visited the three test sites six to eight months after construction to evaluate their performance and performed an economic analysis to compare upfront costs.

MINNESOTA DEPARTMENT OF TRANSPORTATION

RESEARCH SERVICES & LIBRARY
OFFICE OF TRANSPORTATION SYSTEM MANAGEMENT

continued

"Some areas have limited aggregate sources, and producing brand-new gravel to haul is getting more and more expensive. Mixing fines into a road's existing aggregate is another option for agencies, but several factors determine whether it's effective and economically feasible."

—Bruce Hasbargen,
Beltrami County Engineer

"On a gravel road, traffic stirs up dust that is the binder holding the road together. If the dust gets blown away, larger rocks become loose on top of the road and are a safety hazard, making it harder to drive."

—Charles Jahren,
Professor, Iowa State University Department of Civil, Construction and Environmental Engineering

Produced by CTC & Associates for:
Minnesota Department
of Transportation
Research Services & Library
MS 330, First Floor
395 John Ireland Blvd.
St. Paul, MN 55155-1899
651-366-3780
www.mndot.gov/research

Researchers used motor graders to blend crusher dust with loose aggregate floating on the road surface. This was intended to restore fines that bind the aggregate. The effectiveness of the procedure depended on the plasticity of the available crusher dust.

What Did We Learn?

In Jackson County, the added crusher dust was almost undetectable seven months after construction. Loose aggregate in both test sections was 40 percent higher than that in the control section, likely because the crusher dust used in Jackson County was crushed stone that had zero plasticity to help bind aggregate. Crusher dust that contains clay or certain types of limestone would offer better binding qualities.

In Beltrami and Olmsted counties, the experimental sections all performed adequately. Economically, the test sections in Beltrami County provided significant cost savings over the control section. The section that received 83 tons of crusher dust cost $3,100 (36 percent) less than the aggregate control section, while the section that received only 50 tons of crusher dust saved $5,200 (61 percent). In Olmsted County, costs were almost identical for all four sections.

What's Next?

This research suggests that the aggregate rejuvenation procedure is viable and economically sound under certain conditions. It will provide local agencies an option to save money while treating their gravel roads if a suitable binder is available and less expensive than locally available aggregate.

While the experience in Beltrami County suggests that the lower quantity of crusher dust that was mixed in performed adequately and reduced costs, the road needs to be monitored to evaluate performance in the long term and ensure that costs remain lower in the overall life cycle.

Other states have tested the possibility of adding clay to gravel during the crushing process to improve the resulting dust's binding ability. It also may be possible to inexpensively acquire fines from limestone quarries for use on (nonlimestone) gravel roads in some situations. Both options may warrant further investigation for use in Minnesota.

This Technical Summary pertains to the LRRB-produced Report 2015-04, "Aggregate Road Surface Rejuvenation," published January 2015. The full report can be accessed at http://www.lrrb.org/PDF/201504.pdf.