

Pulverization on Local Roads

Pulverization uses 100 percent of existing materials, corrects cross-section problems, and increases the load-bearing strength of the base.

Pavement life and durability depend on timely maintenance measures that keep a road in good condition as long as possible. When routine crack filling, seal coating, or thin overlays no longer are effective, road reconstruction or rehabilitation are the alternatives.

Over the past decade, more Wisconsin counties and municipalities have chosen rehabilitation to repair roads with a PASER (a one to ten rating system based on a windshield survey) rating of four or less, using in-place pulverization of materials as a practical way to rebuild seriously deteriorating roads.

A common and effective pulverization technique for these roads is full-depth reclamation (FDR). FDR involves pulverizing and compacting the bound asphalt pavement layers and base material together, sometimes with stabilizing agents, to produce a good quality base for the rebuilt road.

Standard specifications in Section 325 of the Wisconsin Department of Transportation term this process “pulverized and re-laid pavement.” Model specifications in the Wisconsin Transportation Information Center (<http://tic.engr.wisc.edu>) bid documents for road construction also use the WisDOT language to describe in-place pulverizing of existing asphaltic pavement and underlying base materials to construct a new base.

The Asphalt Recycling and Reclaiming Association (ARRA, www.arra.org) notes that besides utilizing 100 percent of existing materials, pulverization corrects cross-section problems and increases the load-bearing strength of the base. A typical pulverization takes a day to complete and allow

local traffic to resume.

Bill Kahl, owner of WK Construction in Middleton, WI, works on pulverization projects in Wisconsin and neighboring

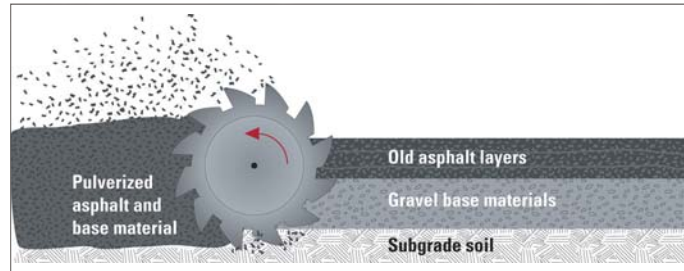
states. He has seen road recycling grow in popularity in Wisconsin as local governments look for alternatives to costly reconstruction.

Slower to gain endorsement in Wisconsin, Kahl says, is the use of additives to stabilize the base materials. WK uses asphalt emulsion or foamed asphalt on most FDR projects. Other additives on the market include cement, fly ash, and lime. The most effective additive depends upon the type and condition of the existing base and subgrade soil. Experienced contractors or materials consultants can help local governments evaluate the additive question as part of a site evaluation.

Evaluate Existing Road

A site evaluation of the road is critical before investing time and money on a solution. In most cases, this means taking core samples or digging a hole to examine road layers. Core samples should reveal:

- Number and thickness of layers.
- Quality and composition of each layer.
- Make up of subgrade soil.



Cross-section illustrates pavement layers typically involved in pulverization and combined in the recycled base materials.

- Good or poor drainage.

Knowing the layers of old asphalt, gravel, and chip seal that make up the existing road helps in evaluating the cause of deterioration. It also points to which approach is the best for rebuilding the road to last. A sieve analysis of base and subbase layers measures the amount of silt and clay and helps determine what, if any, stabilizers to use.

If a core sample includes subgrade soil, it confirms soil type and also answers the additives question. Does the mix of sand, clay, silt or other material create a firm or weak subgrade? If the latter, a stronger pulverized base and



The pulverization process grinds and combines old asphalt layers with existing base materials to create a strong base for new overlay.

thicker reclaimed surface will spread the load better.

Ron Chamberlain, Adams County (WI) Highway Department Commissioner, says he depends on information from core samples for every aspect of a pulverization project. "Core samples really guide us from start to finish," Chamberlain says. "We hire a soils firm to analyze the cores and come up with a pavement design. The core tells us what if any aggregate to add after we pulverize and, finally, our additive contractor uses it to choose and apply the product that goes into the final shaping and grading of the recycled base."

Along with knowing road composition, local officials need to define traffic loads on the reconditioned road and factor that into the redesign. A low-volume secondary road requires fewer inches of reclaimed base than a primary road subject to heavy traffic.

Practical Fix

Local governments around Wisconsin consider pulverization a practical fix for the worst roads, a proven solution tailored to conditions. The City of Oak Creek has pulverized all low-rated roads since 1994. It contracts with an outside vendor for both the pulverization and paving work. Brian Johnston, a civil engineer with the city, reports that a stretch of road pulverized in 1994 and finished with a three-in. asphalt overlay, rated a five this year on the PASER scale, which generally calls for treatment with sealcoat or a thin, non-structural overlay.

Johnston describes a 2007 project reclaiming a deteriorated industrial park road that included first-time installation of curb and gutter. Drainage on the road improved from almost flat to a three-percent slope. Crews pulverized 16 to 20 in. of asphalt and stone into a base. Despite raising the pavement anywhere from zero to 12 in. to accommodate the curb-and-gutter work, they had ground-up product to spare. "We always try to use all material on site and avoid hauling anything in to create the base," Johnston says. After pulverizing more than 6,000 ft of pavement, the contractor actually hauled away about 425 cu yd of excess material.

Without adding a stabilizing agent, the contractor graded the pulverized base, rolled it, and let traffic back on the road for a period of time to pack it down and break up any large particles. After proof-rolling the road with a 20-ton truck to check for soft spots, crews applied a six-in. asphalt overlay, appropriate to a road with heavy truck traffic.

Iowa County (WI) Highway Commissioner Leo Klosterman says seeing the results of pulverization on a stretch of county highway C next door in Sauk County persuaded him to consider the process three years ago. "It intrigued me as an option for projects

here because we've got many miles of bad road where the banks and shoulders remain in good shape. A typical overlay repair would raise the road and create a steeper grade at the shoulder," Klosterman says. "Pulverization offers an alternative that doesn't disturb the ditch line or anything."

Rather than own or run the equipment to pulverize, Iowa County hires a contractor. County highway crews then spread the overlay, working from their own hot-mix plant. Klosterman says this approach makes best use of local resources and a downsized staff.

He reports that the first roads they

PCA and FDR

Full-depth reclamation (FDR) with cement can effectively extend pavement life in a cost-effective manner, according to a new study by the Portland Cement Association (PCA).

Although FDR has been used on pavement projects for more than 20 years, no long-term study had been conducted on its performance. The new PCA report examined the long-term strength and durability of more than 75 projects in eight states. The analysis observed no cases where the reclaimed cement-stabilized base led to severe road distress.

Each road was evaluated using a "pavement condition index" that rated the type, extent, and severity of damage. The average range for the FDR projects was 88 to 97 percent, indicating excellent performance.

FDR with cement is a procedure where failed asphalt pavements are pulverized and reclaimed in place, using cement to stabilize the recycled materials and create a new pavement base. This cement-stabilized base is then surfaced to provide a new, long-lasting pavement structure. It is increasing in popularity as state, county, and city highway agencies have discovered that the process can cost 30 to 60 percent less when compared to conventional reconstruction methods. It also can be

completed faster and without as much traffic disruption.

"The economics of the FDR with cement process has helped highway agencies reconstruct 50 to 100 percent more projects than with conventional construction methods," says Greg Halsted, PCA's pavement program manager, "FDR is a good fit for public officials looking for ways to stretch their road maintenance dollars."

Additionally, FDR is an environmentally sound construction method. Because it recycles old pavement into new base, it conserves natural resources and the energy required with the "remove and replace" construction technique.

The complete research report is available as "Full-Depth Reclamation with Portland Cement: A Study of Long-Term Performance." For more information or to order, visit the PCA Bookstore at www.cement.org/bookstore. Orders can also be placed by calling 800-868-6733. Additionally, PCA recently released "Guide to Full-Depth Reclamation," a step-by-step process, from initial site investigation, to mix design, and construction. For further information please go to (www.cement.org/newsroom/EB234_112707.asp).



Before (shown here) and after photos (below) of a section of the Northbranch Industrial Park road...

treated with pulverization “are holding up well” with few if any cracking problems.

Stabilizing Base and Subsoil

Adams County, WI, ran its own reclaiming equipment for about six years. Today, with real competition in the private sector for pulverization projects, Chamberlain says he also finds it cost-effective to hire contractors with the latest equipment to handle pulverization. The county’s positive experience with the process also inspired it to experiment with different methods of stabilizing the pulverized base and the subsoil underneath.

Since 2004, the county has used an additive on projects that Chamberlain says works exceptionally well. Using core sample readings as a guide, they add an asphalt emulsion to the pulverized product. HG Meigs of Portage, WI, was hired to prepare and spread CSS-1H, a cationic slow-setting asphalt emulsion designed to strengthen the recycled base.

An asphalt distributor truck spread the emulsion over the reclaimed material and a reclaimer followed behind to mix it in. Chamberlain says emulsion and application added between \$15,000 and \$20,000 to the per-mile cost. “The projects where we’ve used the oil show minimal cracking and awesome road stability,” he notes.

Soil stabilization further strengthens the road foundations by improving the ability of weak soils to resist loads. The

process mixes a stabilizer into the subsoil. Adams County, with instances of peat soils, is considering soil stabilization in its pulverization projects, using a mix of cement, fly ash, and water.

For governments, cost saving is an across-the-board consideration on all road projects. Advocates of the method say pulverization pulls the value out of initial

road construction and subsequent overlays by blending in new materials and giving the materials in place new integrity. Twenty years or more in practice, pulverization offers benefits for both saving green and being green:

- Reusing in-place material extracts more out of original investment.
- Stronger base material requires thinner surface layers.
- Less hauling equals lower trucking costs.
- Minimal use of virgin materials reduces impact on depleted aggregate sources.

Kahl says FDR combined with the appropriate additive does, in his experience, produce a road that costs less over time than new construction and lasts longer.

“Local governments are more cost conscious these days, but they need to look past initial costs to analyze the life-cycle of a road,” he notes. “We’ve worked on roads using this treatment that remain in good shape 20 years later.”

Klosterman, Chamberlain, and Johnston echo Kahl’s assessment of cost savings. “Pulverization is very inexpensive for Oak Creek compared to hauling in new material,” Johnston says. He compares the current cost of composite aggregate at \$15.50 per ton—not including haul costs—with the \$1.50 per square yard Oak Creek pays for pulverizing, shaping, and compacting recycled material in place.

The Portland Cement Association estimates that costs for recycling a road normally run at least 25 to 50 percent less than removing and replacing pavement materials.

Innovation also plays a part. Chamberlain says Adams County plans to add crushed glass from a local recycling center to aggregate on future pulverization projects. The alternative appeals because it taps a nearby resource in an aggregate-poor area and puts another recycled material to good use.

Even well-timed and comprehensive



...the City of Oak Creek rehabilitated in 2007 using pulverization. The project also added curb and gutter elements.

maintenance cannot make a road last forever. They all face the need for rehabilitation sooner or later. Pulverization is a practical, reliable approach to restoring the worst roads—and one that, over time, reduces project impact on budgets and the environment. The experience of local governments across the state demonstrates pulverization is gaining traction as a better way to bring local roads back to life. GE

The preceding is excerpted from Crossroads (Winter 2008), a publication of the Wisconsin Transportation Information Center.