

Here's an idea

SH 133 job succeeds with contractor concepts

By Bill Wilson
Editorial Director

The biggest change the Colorado Department of Transportation (CDOT) will pocket came in the form of quarters.

Coring the pavement more frequently led to excellence on the SH 133 job between Carbondale and Redstone, Colo., so much so that it helped win a 2016 ROADS & BRIDGES/Asphalt Reclaiming and Recycling Association Recycling Award.

In the state of Colorado, the rule of thumb

when executing a hot in-place recycling (HIR) project is to core every mile to check the asphalt mix. However, HIR has delivered some challenges statewide.

"We are working through those challenges," Damian Leyba, project manager for CDOT, told ROADS & BRIDGES. "It has been a





learning process for all involved. You need to get the oil content right and you need to reach the right densities.”

CDOT does not spec when a contractor has to core on an HIR job. It is up to the road builder’s discretion, so when United Cos. wanted to check every quarter-mile, Leyba was intrigued.

“I asked them why and they said they would get a better mix design,” said Leyba.

It also would burn another couple of traffic control days, but United Cos. did not receive any resistance from CDOT. A contractor can always go off of historical data in Colorado, but sometimes those numbers are outdated. If maintenance crews come in and throw down a chip seal, the formula would be skewed for the HIR work.

“So coring it saved a lot of brain damage,” said Leyba. “We had an accurate reading of

what was out there and the contractor then submitted its mix design to CDOT and we were able to go forward.”

CDOT contracts will read differently in the future, all thanks to the success on the SH 133 project. Contractors will now be required to core every quarter-mile when executing HIR.

Keep applying the heat

Before being rescued, SH 133 from mile markers 44 to 61 was losing its battle to the elements. Alligator and longitudinal cracking were prominent, and rutting had occurred in both the northbound and southbound lanes. Due to budget constraints, crews did some temporary patching and a chip seal to help hold it together, according to Leyba.

It was time to do something more extensive, which is why CDOT went with a \$3.9 million HIR project. Not only was it more

affordable than virgin construction, it also would take up far less time on a route that is only two lanes and is a recreational draw during the warmer months.

The quarter-mile coring created what Leyba believed to be one of the best mix designs in Colorado. It was a Superpave mix, HIP medium that called for 75 gyrations. The average AC content was 6.6% and the contractor used a PG 58-28 binder. The mix also contained 97% RAP, and the contractor was allowed to use 3% of his own RAP. The average aggregate size was $\frac{3}{8}$ in. to a $\frac{1}{2}$ in.

After the mix design was finalized it was time to send in the milling machines, and that’s when another contractor had a different way of doing things. CDOT specs called for grinding 2 in. of pavement in at least two passes. Dustrol wanted to use a propane heater and take off a $\frac{1}{2}$ in. in four



The Superpave mix employed on SH 133 contained 97% RAP. The average asphalt content was 6.6% and the contractor used a PG 58-28 binder.

passes. So the propane heater was followed by a Caterpillar milling machine (Dustrol used four of them), which took off the 1/2 in. When contractors chew 1 in. at a time the process can be very slow, but heating the existing pavement prior to milling accelerated productivity and significantly reduced downtime due to teeth replacement. CDOT called for 1 mile to be completed every day, and Dustrol was rolling through 2 to 2 1/2 miles daily. The increased production rates saved the project \$25,000 in traffic-control management and inspection.

The extra heat also helped assuage the effects of the higher elevation and the lack of sunlight on the project. Because a good portion of the 17-mile stretch was in a canyon, crews would be lucky to see the sun for two hours on any given day.

"The sun hardly ever hit it," said Leyba. "The constant heating of the mat, it helped a lot."

Coming in behind the milling machines was a Cedarapids MS-5 asphalt windrow elevator, a Cedarapids CR 426R track paver with a 10/20 screed (paving 12 ft wide) and

two Ingersoll Rand DD158 steel double-drum rollers, one serving as the breakdown and the other as the finishing roller. The temperature of the mat was 280°F to 330°F at laydown. A water truck also was used to cool down the new pavement for traffic.

"If you are heating that mat four times it's up to the contractor to determine how creative they want to get with their densities. They could have gotten any density they wanted."

According to Dustrol, because there were different types of asphalt layers used, the rolling pattern varied throughout. A total of

Served cold

Colorado DOT also working with CIR

By Jay Goldbaum
CDOT Pavement Design
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The driving force behind exploring the use of cold in-place recycling (CIR) process in the early 1990s was that the Colorado Department of Transportation (CDOT) was faced with tighter funding and escalating costs of asphalt cement, aggregates and fuel. CDOT also was seeking an economical alternative to rehabilitate seriously damaged roadways that cannot be repaired with simple resurfacing.

Using the CIR process and an engineered emulsion, CDOT is able to:

- Recycle and stabilize the existing materials;
- Get the drivers back on the road in a few hours; and
- Construct a roadway that will perform with minimal maintenance.

Since the mid-90s, CDOT has used the CIR process on over 900 lane-miles of roadway. Typical moderate-to-severe distresses observed in the pavement structures that use the CIR process are:

- Alligator cracking;
- Potholes, moisture damage of the asphalt mix; and
- Longitudinal cracks and/or transverse cracks that extend at least 4-6 in. down from the surface.

Deeper sections have been recycled. However, a two-phase operation was used when processing more than 6 in.

The CIR methodology used for CDOT projects involves milling the existing asphalt

pavement to a specified depth, crushing and screening the milled material to a 1 1/4-in. maximum particle size, then blending it immediately with approximately 1.5% hydrated lime slurry. Typically, CDOT adds about 2% or more of an engineered asphalt emulsion that rejuvenates the old pavement.

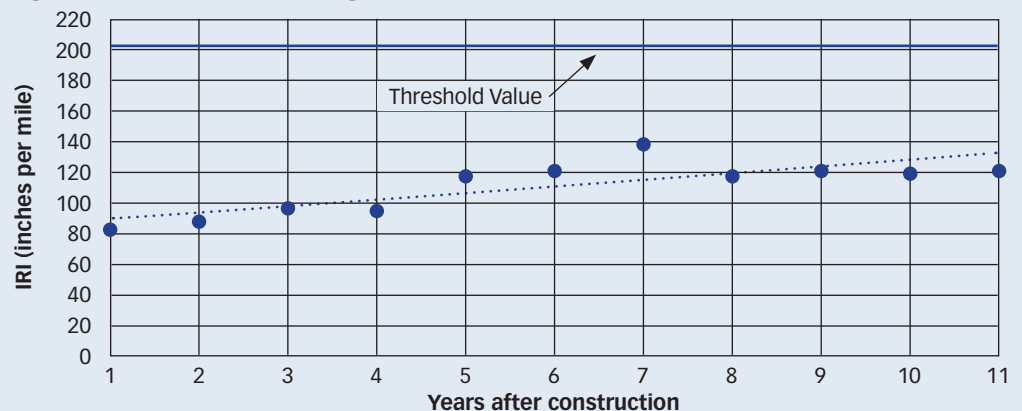
Water may be added to the mixture to aid the mixing process. This practice is integrated into one comprehensive multi-unit train. The resulting new mixture is re-laid at the proper grade and cross-sloped, cured for a short period, then compacted as a new, more durable asphalt base course.

The recycled layer will be stronger, more uniform and more moisture-resistant than the original material, resulting in a long, low-maintenance life. And most



Severe moisture damage in intermediate layers.

Figure 1. International Roughness Index results over time on CIR site.



51 density readings were taken with a Troxler 3440 nuclear soil moist density gauge, with densities falling between 92% and 96%. In total the contractor laid 251,000 sq yd of HIR. Gradation tests were run every 2,000 tons on-site, and at every 10,000 tons a sample was sent to the CDOT region lab to cross-check the readings at the project site.

The contract called for two months for paving. Crews started on June 15 and finished July 10. Total savings on the job was \$250,000.

A profilograph was used to check for smoothness when the job was complete, and

there were no sections that had to be grinded out. Before the project, the existing pavement was averaging 102 in./mile. When work was complete the average was 48 in./mile.

"That road is going to last a very long time," said Leyba. "It is supposed to last eight to 10 years, but now because of the densities they were reaching it should last a lot longer than that."

Because the contractor had to close one of the two lanes to traffic, a pilot car was used to safely guide cars through the work zone.

Rock fall mitigation was conducted

months prior to paving. A contractor scaled three areas of the canyon and checked for loose debris and rock.

"This project is ground-breaking for the state of Colorado. Right now we are still in the stage where we are still trying to figure things out. We encourage the use of RAP. If we can recycle asphalt, it is more environmentally friendly and we don't have to dig into a new pit for aggregate," said Leyba. **R&B**

For more information about this topic, check out the Asphalt Channel at www.roadbridges.com.

CIR train on SH 86 near Kiowa, Colo.



importantly, the costs are about 25-50% less than if the distressed pavement was removed and replaced.

Typically, CDOT has placed 2 to 4 in. of hot-mix asphalt (HMA) over CIR. Depending on the projected traffic, the wearing surface over a CIR base layer may be a double chip seal.

A majority of CDOT's projects were constructed with a 10-year design life on roads with daily truck traffic ranging from 40 to about 2,500 vehicles. An analysis of the last 30 projects estimates the average performance of CIR along with a minor HMA overlay will achieve about twice its design life with only low-cost preventive maintenance treatments.

To estimate the life of CIR projects, annual measurements of permanent deformation (rutting), and transverse, longitudinal and alligator cracking were taken every tenth-mile. The average measurements were plotted against time and the best fit trend line in each distress was used to predict the time at which the distress intercepts the threshold value for rehabilitation. In the following example for International Roughness Index performance, the CIR life is estimated to be 22 years. Overall performance based on all measured types of distress indicates the time to the first rehabilitation cycle to be 24 years.

Since 2002, only three projects have received minor rehabilitation. Two projects were on I-70 near the Utah border with about

2,300 trucks per day. The third project was near Denver on a principal arterial with about 500 trucks per day.

During the past decade, CDOT has conducted several comparative analyses of maintenance costs for pavements. These investigations have brought to light maintenance practices and improved activities that are responsible for enhancing the performance of CDOT's network of over 23,000 lane-miles while reducing the annual cost. Information from CDOT's maintenance management system showed that the work typically done on CIR projects was crack-filling followed by a chip seal, and annual maintenance on CIR projects was about 25% less than average HMA projects.

The results of this analysis were presented at the August 2014 International

and Western States In-Place Recycling Conference held in Denver, Colo., and again at the 2016 Transportation Research Board meeting held in Washington, D.C. Problem statements, based on the 2014 conference, were successfully submitted to the National Cooperative Highway Research Program for FY 2017 consideration.

CDOT will again assist in sponsoring an in-place recycling conference, in coordination with the annual meeting of the Rocky Mountain Asphalt User Producers Group in the fall of 2016. CDOT recently funded internal research to establish design criteria with respect to long-term resilient modulus properties to be used with designing CIR projects with AASHTOWare pavement M-E design software. **R&B**