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HOT IN-PLACE RECYCLING LEVERAGES DENVER FUNDS

Unique process recycles failed pavements into base and tops with fresh hot mix asphalt in one pass

by Tom Kuennen

A hot in-place (HIP) pavement recycling program in the combined City and County of Denver, Colo., is helping that government leverage funds and resurface more streets than would be possible under its conventional, budget-restricted street resurfacing program.

The result is smooth streets, clean work sites and happy residents at a substantially lower cost per square yard than conventional mill-and-fill resurfacing, said Denver's director of street maintenance.

During a pilot program in 2002, most mornings residents would leave a street needing resurfacing, and in the evening would return to a street in like-new condition.

"They left in the morning with 'no parking' signs present, and when they returned the street would

be done and the signs vanished," said Dan Roberts, P.E., director, Street Maintenance Division, Department of Public Works, combined City and County of Denver, Colo.

Denver's program utilizes a distinctive, one-pass, HIP recycling or repaving process that heats, scarifies, rejuvenates and reuses the existing deteriorated asphalt as a 1 inch leveling course, and immediately places on it a fresh 1 inch layer of hot mix asphalt (HMA).

In Denver, this fresh driving course contains 20 percent reclaimed asphalt pavement (RAP), and is supplied by the owning agency. Because both layers are hot when placed, a thermal bond is achieved between lifts, and cold joints are eliminated between driving lanes. Thus no tack coat is needed. The process is unique to the contractor, Cutler Repaving, Inc., of Lawrence, Kan.



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COMMERCIAL, RESIDENTIAL PILOT PROJECTS

Roberts and his staff are responsible for street paving with their two in-house paving crews, cold milling of pavements with two in-house milling crews, and operation of Denver's own Astec hot mix asphalt plant of 300 tph capacity. "We also do pothole patching, large area patching, street sweeping and snow removal in the winter," Roberts said.

Denver's pavement resurfacing program stems from a pavement management analysis that was undertaken in 2001. "We found that in order to maintain our network, we needed to do 50 percent more resurfacing than we could with our existing crews," Roberts said. "The dilemma we faced was that in order to supply the asphalt for a standard 2 inches cold mill and overlay, our plant could not supply three crews, and we'd have to either purchase a significant quantity of asphalt, or acquire another plant."

So in 2002 the city and county of Denver was faced with big decisions. "We were looking at a potential \$10 million expansion of our street resurfacing program to meet the needs identified in our pavement management system," Roberts said. But as government revenues plunged early in the decade, Denver found itself unable to fully fund the needed work using its existing system. Into this gap came hot in-place recycling.

"We did our first hot in-place pilot project in Summer 2001," Roberts said. "It was 41,000 square yards on Speer Blvd., a major arterial in Denver. It was a very busy diagonal street into downtown, and most of the work was done on a weekend. It was a great project and we learned a lot about hot in-place. Some of the huge benefits I saw right off the bat were the incredible smoothness of the finished product, and the cleanliness of the operation because they don't use a tack coat."

NEW STRATEGY FOR PAVEMENT MANAGEMENT

Thus the HIP process — as implemented by Cutler Repaving — enabled a new pavement management strategy for Denver. "From a pavement management standpoint, for us, HIP permits an intermediate strategy between a chip seal and a conventional 2 inch cold mill and overlay," Roberts said. "And the pilot was cost-effective: the final total was \$4.63 per square yard, about a 30 percent cost savings over our standard mill-

and-overlay that same year [\$6.78 per square yard]."

And that was just the cost for the work, not counting intangible costs such as user delays in a busy Sunbelt city. "Conventional mill and paving would have increased the construction time frame by at least 50 percent, because you would have had to cold mill, and then come back and overlay."

With this process, elimination of the tack coat was highly desirable, due to the mixed-use environment of Speer Blvd. in Denver and the abundance of cross streets in this

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diagonal city artery. "In addition it crossed four major arterial streets, and was adjacent to a stream, always a significant issue with respect to use of tack coat," Roberts said.

The result in 2001 was a strong endorsement for future HIP recycling in Denver. "We were very pleased with the HIP recycling project," Roberts said. "We found that Cutler Repaving train doesn't take up any more space than a cold milling operation with trucks up front."

MAXIMIZING RAP USE IN DENVER

While a virgin mix was provided by Denver in 2001, in 2002 Denver supplied hot mix asphalt containing 20 percent reclaimed asphalt pavement (RAP). Now, its repaving program maximizes the use of recycled materials in Denver city and county streets, which constitutes good environmental stewardship, with the potential to generate good public relations.

"Our mix design uses 20 percent reclaimed asphalt pavement (RAP)," Roberts said. "So when you consider that the top 1 inch of mix contained 20 percent recycled RAP, and the existing 1 inch was recycled 100 percent in-place, then 60 percent of the material that was treated or placed was recycled. As one of our informal goals is to reuse and recycle as much material as possible, the project meets agency goals there."

In 2002, Denver undertook a larger HIP project, but still considered it a pilot project inasmuch it was done almost entirely on residential streets. "Again, there was fantastic smoothness on the roadways," Roberts said. "Cutler's Repaver works in a fairly confined space. In curvilinear residential streets with tight curves, the equipment has worked very well."

Two big comments from residents involved the cleanliness of the project, and the coordination of the contractor with residents, he added. "As a contractor, Cutler did a wonderful job dealing with the residents. And follow-up comments involved great ride quality and smoothness. To citizens, aesthetics is a big deal," Roberts said.



Cutler's Repaver works well on streets with tight curves

MOVING AHEAD IN 2003

With another 140,000 square yard HIP-recycled, in 2002 Denver wrapped up its two years of HIP pilot projects. And in 2003, after experience in commercial and residential neighborhoods, Denver city/county proceeded to use HIP recycling in big way.

“In 2003 we went out with our first general contract, consisting of two large residential areas, and 10 arterial roadways, 530,000 square yards of work,” Roberts said. “The work was scattered throughout Denver, with haul distances as much as 15 to 20 miles. We got the same high-quality results for what we paid in 2001, \$4.63 per square yard. All of the work done in 2003 used our recycled mix.”

But in 2004, budget restrictions compelled Roberts to trim back the amount of HIP, to 330,000 square yards. “That will be in two large residential areas,” Roberts said. “Unique to the 2004 program, agency forces using our fleet of 10 live-bottom semi-tractor trailers will replace contracted haulers in bringing hot mix asphalt to the job site. I can keep the staff on-board by using them to haul to the field. That’s helped us reduce our overall agency budget without resorting to layoffs.”

PAVEMENT HEATED TO 300° F

In Cutler’s exclusive Repaving process, the existing pavement is heated to 300° F. When in the resulting softened, pliant condition, the pavement is scarified to a depth of 1 inch, and in the mobile repaving unit, a recycling agent that restores the viscosity of the aged asphalt is mixed into the scarified, reclaimed asphalt.

This reclaimed material then is reapplied and distributed with a screed as a 1 inch leveling course. While that material remains at a minimum 225° F, a virgin hot mix asphalt overlay is placed over the recycled leveling course.



Rebeated edge of repaved lane results in high density seam between lanes

Cutler’s unique Repaving machine scarifies, applies recycling agent, places the leveling course, and applies the new overlay simultaneously in one pass. That benefits road users because there is no delay between the time the pavement is recycled and the time a riding or friction course is placed, resulting in a safer work zone for road users and for contractor personnel.

And because the hot virgin mix is placed over the heated, recycled leveling course, the process achieves a thermal bond between the recycled layer and the new layer.

“From an engineering point of view, there is no delamination between the recycled layer and the new overlay,” said Cutler

vice president John Rathbun. “That’s very important in predicting life cycle performance. The same heat that’s used to take the road apart is used to put it back together, and the two layers are effectively compacted into one lift.”

HOT SEAMS PREFERRED

Repaving also reheats the edge of adjacent repaved lanes, resulting in a more durable, higher-density seam between the driving lanes. “I like to see the hot seams, because with this process you know you will not have a cracking problem on that job down the road,” Roberts said.

The entire machine moves forward at a rate of 18 to 25 feet per minute. The virgin surface is applied by a four-section vibratory screed no more than 3.0 feet behind the leveling course screed, fed from a hopper at the front of the Repaver via a drag/slat conveyor chain which brings the HMA through a tunnel along the length of the machine, to the paving screed. The result is a monolithic,



Vibratory screed applying new HMA overlay



Reclaimed asphalt is reapplied and distributed with a screed as a 1 inch leveling course

2 inch, finished pavement that is equivalent in ride to a 2 inch mill and overlay.

The complete HIP repaving pass takes place over a very short time, meaning traffic barricades can come down quickly, with all reclaimed material used on the spot without hauling, so user delays are kept at a minimum compared to conventional mill-and-fill recycling projects.

Traffic can drive on the new pavement as quickly as with conventional paving, while driveways and intersections are blocked for about 15 minutes. And the objectionable tack coat ahead of HMA paving is eliminated.

HOT IN-PLACE BOOSTS PAVEMENT PROGRAM

By using a HIP recycling strategy as an intermediate between full-scale, 2 or 3 inch mill-and-overlay at one end, and chip seals at the other, Denver has reduced its pavement management costs.

“In the long run, by implementing this HIP strategy, we’ve reduced our pavement management costs by 15 to 20 percent overall,” Roberts said. “We will not have to incur additional, upfront capital and labor costs to get the work done.”

As stated, those capital and labor expenses were scheduled for implementation in a 2004 – 2005 time frame. “But we’ve had budget problems just like all other government agencies, and we see now that wouldn’t have happened,” Roberts said. “Now we can keep our pavement conditions as high as we can without the capital expense.”

In fact, the program has faced substantial cuts in the past two years, which means Denver is barely treading water in holding to its pavement

condition plan. “We’ve faced big cuts in 2003 into 2004,” Roberts said. “Our agency has reduced its overall budget by 18 percent, but we’ve still been able to sustain a significant resurfacing program, largely due to implementation of our hot in-place recycling program.”

\$4 million from what we have been getting,” he said. But improvement is coming. “While in 2004 we experienced specific one-time budget cuts and changed our program dramatically, in 2005 I anticipate achieving about 90 percent of our target in maintaining existing street condition,” Roberts said.

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In 2004, in light of funding decreases, total street conditions are declining, Roberts said. “We need to increase our overall funding by about \$3 million to

Denver uses a composite pavement condition index methodology, of 1 to 100, where 100 is tops. “We’re just below 80 on a composite condition index [average for all pavements],” Roberts said. “But 2005 should be the year it is brought up to 90 percent of our indicated level for pavement management.

“Frankly, our arterial and collector network is in a lot better shape than our residential streets,” he said. “We have a 500-centerline-mile backlog of residential streets that we need to clear. But for some years prior to 2000, due to budget constraints, virtually all work done to resurface pavements was limited to arterials and collectors. The hot in-place technique is a significant strategy that will help us catch up on that backlog.” ■

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