

HOT IN-PLACE RECYCLING HELPS DENVER MEET ITS SUSTAINABILITY GOALS

'BETTER DENVER' CAPITAL PROGRAM BUILDS ENVIRONMENTALLY SUSTAINABLE PROJECTS; HOT IN-PLACE RECYCLES WITH LOWER ENERGY, EMISSIONS PROFILE

By Tom Kuennen

The combined City and County of Denver is benefiting from a late-November 2007 tax increase which bolstered its streets program. As part of this *Better Denver* program, in addition to

"We made the decision to dedicate a big chunk of that tax increase to hot in-place recycling," Roberts said.

LEED-ND PROVIDES DENVER'S CRITERIA

Succeeding along with the November property tax increase for streets was a \$550 million bond initiative, all under the *Better Denver* program.

"Sustainability guidelines and targets are part of the construction that will take place under *Better Denver*, Roberts said. "The targets were established by the mayor under an executive order. For 'vertical' construction, that is buildings, the guidelines from LEED are clear. It's not so clear for horizontal construction, like roads, because there is no national standard."

But the criteria are evolving. Denver's evaluation of horizontal projects is based on an adaptation of the *Leadership in Energy and Environmental Design* program of the U.S. Building Council. LEED certification is a new driving force behind value-added private and public sector infrastructure design and construction, and the building industry has turned to the LEED system to evaluate the degree of "green" design a structure or development incorporates.

The LEED Green Building Rating System is a voluntary third-party rating system in which credits are earned for satisfying specified green building criteria. Projects are evaluated within six environmental categories: *Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Innovation & Design, and Indoor Air Quality*.

The new LEED-ND (for *Neighborhood Development*) certification category addresses complete multi-unit projects, including pavements, and Denver's scoring of "horizontal" projects like roads is based on the LEED-ND criteria.

Hot in-place recycling meets Denver's own criteria of sustainable construction based on LEED-ND via use of building materials with recycled content of at least 10% (based on cost) of the total value of the materials in the project; recycle and/or salvage with a goal of 50% (by weight or volume) of non-hazardous construction and demolition debris; use of regional materials with a minimum of 10% (based on cost); and project design or purchase equipment to achieve a 15% energy reduction.

named capital projects, a maintenance fund was created to protect street infrastructure with preventive maintenance down the road.

But environmentally sustainable construction also is a key component of the *Better Denver* program, and Denver is increasing its use of hot in-place recycling in order to meet Denver's sustainability criteria, in terms of amount of material recycled, and cumulative emissions as opposed to other maintenance methods.

"In November we passed a property tax increase that's dedicated to maintenance of existing infrastructure," said Dan Roberts, P.E., deputy manager for operations, City and County of Denver. "It increased our street resurfacing program budget by about \$6 million in 2008, and that's translated into an increase in our hot in-place repaving program. It's not just a cost-effective method, but it's a more-sustainable street resurfacing program, environmentally speaking."

In 2008 Denver's hot in-place program will top \$3.5 million, covering 600,000 square yards, some 40% of the total street resurfacing program.



Cutler's recycling train completes another residential collector street for the city of Denver, CO.

For its growing hot in-place recycling program, Denver exclusively uses a process from Cutler Repaving, Inc.

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HOT IN-PLACE REPAVING

For its growing hot in-place recycling program, Denver exclusively uses a process from Cutler Repaving, Inc., Lawrence, Kan. With repaving, the existing pavement is heated to 300 deg F. When in the resulting softened, pliant condition, the pavement is scarified to a depth of 1 in., 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 deg F, a virgin hot mix asphalt overlay is placed over the recycled leveling course.

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."

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.

SMALLER ENERGY, EMISSIONS PROFILE

In addition to the benefits of recycled material, hot in-place recycling as executed by Cutler provides a smaller energy consumption and emissions profile cumulatively than nearly every other surface reconstruction method.

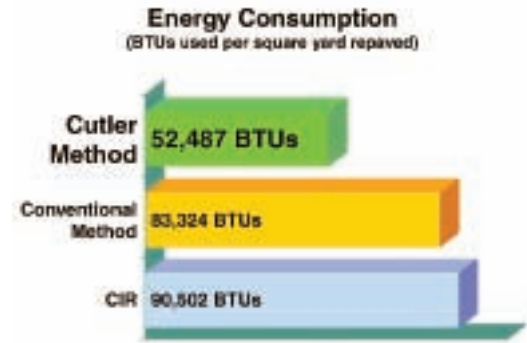
Repaving's lower energy consumption is important for both cost savings and resource conservation, but also figures into the LEED-ND evaluation of the process for *Better Denver*.

According to new research, despite the propane-powered heat used to soften the existing road surface prior to recycling, hot in-place re-

Cutler's single pass recycling process completes the recycling and resurfacing simultaneously, thereby minimizing delays to the traveling public.

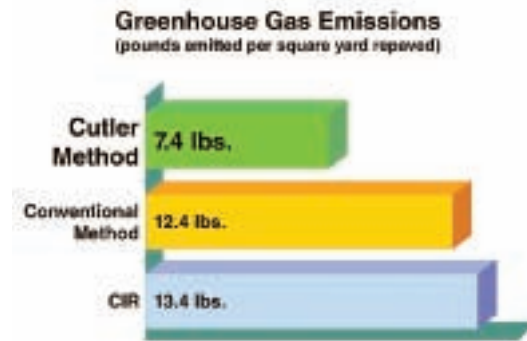


paving of 1 in. existing pavement, topped by 1 in. virgin overlay uses fewer BTUs per square yard (52,487) than either 4-in. cold in-place recycling with 1.5-in. hot-mix asphalt overlay (90,502), or 1-in. cold-mill with 2-in. overlay (83,324).



Only cold in-place recycling with emulsified asphalt surface treatment used fewer BTUs per square yard than the hot in-place repaving (39,788), but it will lack the long-term durability or smoothness of hot in-place surface repaving topped with either virgin mix, or mix containing up to 40% reclaimed aggregate pavement (RAP), as is done in Denver.

Hot in-place repaving also features a significantly lower greenhouse gas emissions profile in terms of pounds emitted per square yard repaved. Repaving of 1 in. existing pavement, topped by 1 in. asphalt overlay containing 40% RAP emits only 7.4 lbs. of greenhouse gases per square yard, compared to 12.4 lbs. for 1-in. mill with 2-in. overlay, or 13.4 lbs. for 4-in. cold in-place recycle topped with 1.5-in. asphalt overlay. Only the cold in-place with surface treatment scored lower.



The data were compiled by Doug Cutler, executive vice president, Cutler Repaving, using research from COLAS, S.A., the big French road builder and materials supplier. “Our starting point was our work in Denver in 2007,” Cutler said. “We took the amount of propane and off-road diesel fuel we consumed on the projects, and extrapolated the figures using an overlay with 40% RAP, as we did in Denver.” The other data were sourced from COLAS in its publication, *The Environmental Road of the Future*.

“The implications are that hot in-place recycling is a good way to go if you want to achieve carbon savings,” Cutler said. “A lot of people assume that because we use propane to heat the pavement to rework it, that it’s not necessarily carbon-efficient. But we achieve our savings by working material in-place on the road, not having to transport it back and forth, with less virgin materials consumed.”


DEDICATED TO HOT IN-PLACE

As Denver is located in an environmentally aware region, all this works to Denver’s advantage in its growing use of hot in-place recycling. Roberts has calculated that hot in-place is one-third the cost of a traditional 2-in. mill and overlay, but with 80% of estimated service life of that mill and overlay, and with 67% longer life than a chip seal.



Denver is looking at alternatives to make its hot in-place pavements last longer. It’s used both crumb-rubber modified asphalt and stone-matrix asphalt mixes as the overlay on hot-recycled surfaces using the Cutler technology. “We are seeing some unanticipated cracking in the crumb rubber overlays, but for the SMA, after a test in 2006 and limited use in 2007, we will be using SMA on many of our repavings by Cutler this year,” Roberts said. “We will be putting down an inch of SMA, but may bump to an inch and a half.”

And all of this is unfolding against the backdrop of today’s environmentally sustainable pavements. “Denver’s Mayor John Hickenlooper has established a climate action plan with a number of sustainability goals,” Roberts said. “They include reuse of material, reduction of carbon footprint, and reduction of energy consumption. Hot in-place recycling helps us achieve those goals as we look program-wide across the street resurfacing program.”



The finished pavement produced by Cutler’s Repaver consists of 60 percent recycled asphalt, saving not only valuable non-renewable natural resources but also scarce tax dollars.