THE UNIVERSITY OF TEXAS AT AUSTIN ✦ COCKRELL SCHOOL OF ENGINEERING
TEXAS PAVEMENT PRESERVATION CENTER
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## HIR Open House and Workshop



### TPPC Board of Directors



### Our Mission

The mission of the TPPC, in joint collaboration with the Center for Transportation Research (CTR) of the University of Texas at Austin and the Texas Transportation Institute (TTI) of Texas A&M University, is to promote the use of pavement preservation strategies to provide the highest level of service to the traveling public at the lowest cost. The executive sponsor for the TPPC is the Texas Department of Transportation (TxDOT).

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### Past and Upcoming Events

**Hot In-Place Recycling**

The Hot In-Place Recycling (HIR) Open House and Workshop was held in Fort Worth on October 29, 2009. The workshop was jointly sponsored by Cutler Repaving, Inc., Martin Asphalt Company, the City of Fort Worth, FP2, and the Texas Pavement Preservation Center. The implementation methods and potential benefits of hot in-place recycling were presented by John Rathbun, and Bill O'Leary described the additives used in HIR. Yetkin Yildirim described HIR in relation to pavement preservation, and Najib Fares, infrastructure manager for the City of Fort Worth, described his first-hand experience with hot in-place recycling methods. Videos of this workshop and additional instructional materials regarding hot in-place recycling are available for use online at:
http://www.utexas.edu/research/tppc/conf/HotInPlace

**TPPC Seal Coat Training Courses**

Seal Coat training courses will continue to be offered by the TPPC. The course designed for inspectors, entitled "Seal Coat Inspection and Applications," focuses on proper inspection methods and the equipment used during chip seal construction. The other course, "Seal Coat Planning and Design," instructs engineers on planning, designing, and constructing chip seals.

For more information on the Seal Coat courses, please contact Dr. Yetkin Yildirim, P.E. at yetkin@mail.utexas.edu or (512) 232-3084.

***Hot In-Place Recycling***

**"Additives Used in HIR and the Benefits"** presented by Bill O'Leary, VP of Martin Asphalt Company

## The Rising Cost of Asphalt

The Hot In-Place Recycling Open House and Workshop began with a brief overview on what asphalt cement is and where it comes from. Most asphalt is the byproduct of crude oil refining. However, only some crudes produce asphalt and finding crudes that are available for asphalt production is becoming more and more difficult. This stems from the fact that innovations in fuel refinement have made previously unusable forms of asphalt viable for fuel productions. This coupled with the rising price of crude oil has resulted in a steady increase in the cost of asphalt production.

Ever-rising costs present a problem due to the natural aging process of asphalt pavement and its inevitable need for maintenance. Asphalt pavement slowly oxidizes when exposed to air and water, causing the material to become stiffer, thicker, and brittle with age. These factors combined with the constant stress caused by vehicular loading results in the inevitable raveling, cracking, and eventual base failure that will occur with all asphalt pavements. Because of this aging process and asphalt pavement's inevitable need for repair, new ways of maintaining or recycling the asphalt material are necessary.

Pavement engineers are attempting to solve these problems through a process of preventive measures. It is far more cost effective to catch defects in the asphalt pavement early on because the cost of preventive measures are far less than the cost it would take to rehabilitate dilapidated asphalt material. Rehabilitation can cost up to ten times the amount that equally effective preventive measures would cost.

## Components of Asphalt

In order for this to be a successful procedure, an acute knowledge of the properties and components of asphalt is required. Asphalt contains three key ingredients, and finding the appropriate balance between these components in the mixture is the key to successfully recycling asphalt. Newer asphalts known as "super binders" contain roughly 15% asphaltenes. These asphaltenes act as the skeleton that the rest of the asphalt builds upon. Secondly, it is important to keep the amount of saturates as low as possible in the mix. These saturates are wax-like hydrocarbon molecules that contribute to weaker bonds between the materials in the asphalt. Lastly, the asphalt mixture must have a healthy amount of polar and naphthalene aromatics. These glue-like components are composed of open bonds and are the most important component when trying to polymer-modify the asphalt material. Other authorities in the field will argue that all that is needed in recycling asphalt is to mix recycling agents into uprooted asphalt.

**Separated Asphalt Components**

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**"Implementing HIR in Both a City and Highway Agency"** presented by John Rathbun, VP – Sales, Cutler Repaving, Inc**.**

Growing in popularity as a pavement rehabilitation measure is the hot in-place recycling (HIR) method. This process involves heating, loosening and rejuvenating the top one to two inches of an existing asphalt pavement while simultaneously applying a hot-mix-asphalt (HMA) overlay while the temperature of the recycled layer is still above 200º F.

## Proper Pavement Preservation Candidates

Before any pavement preservation measures should be taken, it must be determined whether or not the road in question is a good candidate for hot in-place recycling. Proper pavement preservation applies the *right* treatment on the *right* road at the *right* time. Good candidates for hot in-place recycling are roads that show rutting, wearing, cracking, aging, or poor frictional characteristics. A poor candidate would be a road that shows unstable subgrade, wide transverse thermal cracks, asphalt stripping from aggregates, structural defects or lack of structural capacity, or a presence of geotextile fabric within the top two inches of the existing pavement. According to Ruthbun, HIR is the one of best preservation treatment to address the surface distresses within the top two inches of existing pavement.

**Surface Recycling**

**Cutler Once-Over Repaving Process**

Once it is determined that a road is a suitable candidate for the HIR process, one of three HIR methods must be used to improve the road. The first, surface recycling, consists of heating, loosening, rejuvenating and relaying an asphalt pavement in place. This method uses a preheater to loosen the surface asphalt, then applies recycling agents to the loosened asphalt, then the asphalt is laid back down. In the second method, remixing, the asphalt is heated, loosened, and then sent into a pug mill where it is mixed with new material, then laid as either the surface or binder course. In repaving, the top surface is heated, loosened and rejuvenated, then laid down in place as a leveling course. While the leveling course remains above 200º F, an HMA overlay is laid on top.

These HIR methods have varying degrees of appropriateness depending on the condition of the road in question. HIR is most appropriate when the road shows raveling, potholes, skid resistance, fatigue cracking, or edge, slippage, block, longitudinal, transverse, and reflective cracking. HIR is less appropriate, but still viable when the road shows bleeding, rutting, corrugation, marginal existing pavement strength, swells, bumps, sags, or depressions.

While all three HIR methods are currently in use, Cutler Repaving only uses the repaving method. Repaving is argued by many as better to remixing and surface recycling because repaving is the only HIR process that interlocks the aggregates of the recycled layer with that of the overlay. Additionally, repaving uses 50% less materials than other conventional methods. If that's not enough, while repaving expends approximately 52,000 BTUs per square yard, the "mill and fill" method expends 83,000 BTUs per square yard, and "cold in-place recycling" expends 91,000 BTUs per square yard. Greater efficiency translates into lower greenhouse gas emissions as well. Repaving expends 7 pounds per square yard of greenhouse gasses, while "mill and fill" expends 12 pounds, and "cold in-place" expends 13 pounds.

## Six Steps of Repaving

As a result of the specialization of only using one kind of HIR method, Cutler Repaving has devoted their resources to streamlining the process by developing and manufacturing a 65 foot long machine that is capable of completing all of the repaving process' six steps in one pass. First, heating hoods fueled by propane are lowered over the damaged road. The pavement is slowly heated to 375º F – a high enough temperature for the pavement to loosen.

**Underneath Heating Hood**

Second, loosened pavement is scarified with carbide tipped teeth. By doing this rather than milling the asphalt, the risk of aggregate degradation, or damaging of the pavement's skeleton, is greatly reduced. Third, the uprooted pavement is mixed with polymer-modified recycling agents. Fourth, the new mixture is laid back on the road with a recycling screed. The mixture is still above 200º F because no more than 30 seconds has passed since the surface was uprooted at the temperature of 375º F. Fifth, a virgin hot mix is spread over the recycled

material. What is left is one inch of recycled material on bottom and one inch of new material on top.

**Applications of 1" Virgin Hot Mix**

In contrast, the remixing method takes the recycled material and the new material and mixes them together. Such a method results in a weaker surface when compared to a surface composed of a recycled material leveling course covered by a fresh wearing course. The sixth and final step is the compaction of these two layers using double-drum laboratory rollers.

With this machine, these six repaving steps are completed in one pass. Such efficiency translates into a more cost effective project, as well as limits the time of inconvenience to commuters. On a highway without restricted hours, the machine can repave up to two miles a day. Such efficiency has directly translated into more projects.

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## "Pavement Preservation and Hot In-Place Recycling"

presented by Dr. Yetkin Yildirim, Director of TPPC

For years, the traditional approach to road maintenance has been used on our nation's roads and highways. This approach concentrates all of our resources on corrective maintenance, or maintenance that must be done in response to events that cannot be planned, or as reactive repairs. Several research studies that were conducted in an effort to improve the maintenance methods and life of roads have revealed that pavement preservation is a far more effective and cost efficient method of maintaining roads. Preemptive efforts to preserve the structural integrity and functional condition of our roadways have been on the table for the past three decades, but have not been strongly promoted until the past ten years.

### Pavement Preservation

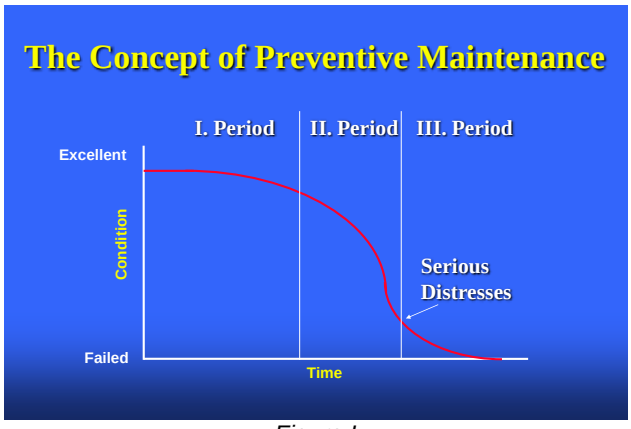


*Figure I*

Characteristics of a good pavement include fine drainage, a strong foundation, and acceptable thickness. These properties all get exponentially worse with time. Minor cracks allow water to seep through the pavement, resulting in more extensive damage as the cost to repair the pavement rises exponentially. Pavement preservation attempts to never let pavement fall below "Period I" in its three period aging process as illustrated in Figure 1. However, retroactive maintenance will never bring the pavement back to its original quality.

A proper pavement preservation strategy addresses the pavement while it remains in a good condition. If the onset of serious damage is allowed to occur, cost effective treatment would no longer be an option. However, if pavement preservation methods are applied at the right time early in the life of the pavement, the service life of the pavement can be increased significantly. To gain full benefit from adoption of pavement preservation tactics, it is essential to understand what causes the physical wear and tear on the pavement. Knowing the source of the problem will result in a better ability to stave off the effects.

**Pavement After Crack Sealing**

When considering whether a road needs work, certain things must be taken into account. The existing pavement condition, the climate and weather conditions surrounding the road, the properties of the materials available, the traffic load expected on the road, and local restriction are all important factors to consider when determining the appropriate time for application of pavement preservation methods. In short, it must be determined that it is the *right* treatment for the *right* road at the *right* time.

### The Importance of Education

The only way to ensure that these decisions are being properly made will come from education and training. Texas Pavement Preservation Center (TPPC) provides training in the area of pavement preservation. Additionally, the center studies proper research implementation and does strategic planning for research.

Several research efforts spearheaded by TPPC have made helpful innovations on seal coats, crack sealing, thin asphalt overlays, and warm mixes**.** A new patent by TPPC, a stress absorbing layer for seal coats, has offered a method for enhancing the performance and providing longer service life to existing roadways. In three tests, seal coat was tested against a control group on different roads around the state of Texas and were monitored for three years. First, stress absorbing layers for seal coat was applied on the existing cracks on the test sections. After application of stress absorbing layers, seal coats were applied on the test sections and control sections were constructed without the application of stress absorbing layers. These tests found that test sections with stress absorbing layers showed superior performance in comparison with the test sections without stress absorbing layers – cracks did not show up on the surface of seal coats where stress absorbing layers were used.

**Test sections: Control section in background and section with Stress Absorbing Layer in the foreground**

In summary, pavement preservation programs extend pavement life, preserve structural integrity, enhance pavement performance, slow progressive failures, improve safety, improve ride quality, ensure cost-effectiveness, and improve mobility. Despite the obvious benefits of pavement preservation programs over traditional methods, these benefits will not be realized without proper training and education of the transportation service industry and the local, state, and nationwide policy makers.

### **"HIR in the City of Ft. Worth"** presentation and Q&A with Najib Fares

Last year, the city of Fort Worth appropriated more than 17 million dollars toward street repairs. Through the employment of hot in-place recycling methods, the city has been proactive in their spending and has been able to repair and maintain far more square footage of roads than would have otherwise been possible.

In the early 1980s, Ft. Worth used HIR. However, the people of Ft. Worth were opposed to the large amount of equipment required, the pollution created by this equipment, and the burning damage to grass, trees, and bushes that this equipment caused. Because of this, Ft. Worth stopped using HIR methods and began using micro-surfacing in 1992.

In 2007, Jim King put on a presentation at University Park for the transportation officials of Ft. Worth in an attempt to showcase innovations on the HIR method. Fares and his colleagues observed the use of HIR being employed on small arterial roads lined on either side by lush landscaping. Fares witnessed a smooth operation with minimal inconvenience to commuters, few signs of pollution from the machines, and absolutely no burn damage caused by the machines to the near-by grass, trees and bushes.

**Mountain Pass Repaving Job**

As a result of this demonstration, the city of Ft. Worth decided to give HIR a second chance 15 years after abandoning the process. They were satisfied with the results. The first HIR project produced quick results, a smooth ride, and seams that were joined together perfectly. Additionally, after a year, reflective cracking was not present. All of this was done for cheaper than it would have cost the city using their previous methods. With these better than expected results, the city has since gone back to using HIR methods on most of their pavement preservation and road repair needs.