

# Hot In Place Recycling

Restore  
"System"



# The Process

RESTORE HIR SYSTEM

- ❑ Engineered Emulsion Formulated *for* Process
  - Polymer Modified AC Base
  - Rejuvenating Oils
  - Dictated by Project Mix Design
  
- ❑ Hot In-Place Recycling of up to 2 ¼" of Existing Surface
  
- ❑ Final Surfacing Dictated by Traffic & Road Conditions



# The Technology - Engineered HIR Recycling Emulsion

RESTORE HIR SYSTEM

## ❑ Formulated with

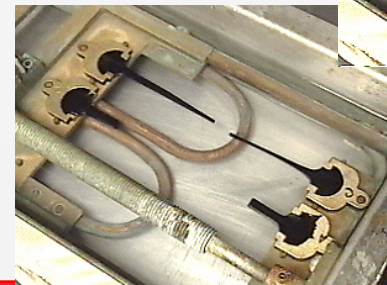
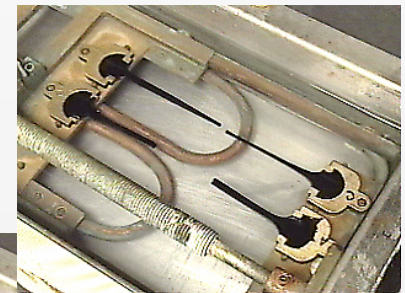
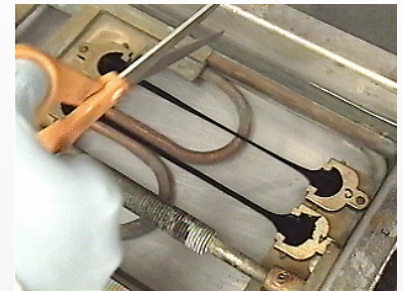
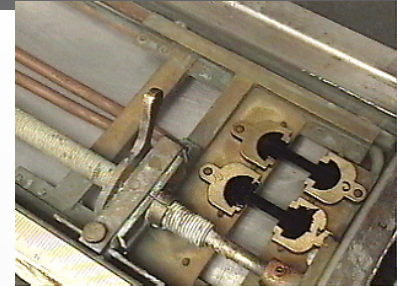
- Rejuvenator
- Elastomeric Polymer Modified Asphalt
- Grade Selected for Project

## ❑ Rejuvenates Aged, Oxidized Asphalt

## ❑ Excellent Aggregate/RAP Coating

## ❑ Polymer Improves

- flexibility & durability
- adhesion
- temperature susceptibility
- strength & rutting resistance
- cracking resistance



# Performance-Related Specifications

<b>Property</b>	<b>Criteria</b>	<b>Purpose</b>
<b>Compaction effort</b> , Superpave Gyratory Compactor	1.25° angle, 600 kPa stress	<b>Density Indicator</b>
<b>Density</b> , ASTM D 2726 or equivalent	Report	<b>Compaction Indicator</b>
<b>Tensile Strength</b> , ASTM D 4867, 25°C	<b>75 lb/in<sup>2</sup> min.</b>	<b>Stability Indicator</b>
<b>Retained stability</b> based on long-term stability	<b>70% min.</b>	Resistance to <b>moisture damage</b>
<b>Asphalt Pavement Analyzer</b> , 60°C, wet	<b>8mm max.</b>	Resistance to <b>rutting</b>
<b>Indirect Tensile Test</b> , AASHTO T322, Modified	LTPPBind temperature for climate & depth	Resistance to <b>cracking</b>

**Also: Mix Design, Construction Equipment, Construction Methods, QC & QA**

# The Process

RESTORE HIR SYSTEM

## □ Continuous Process with Self-Contained Train



- Asphalt Surface Heated
- Heated Pavement Milled in ½” to ¾” increments
- Engineered Emulsion Added at Design Content
- Materials Mixed and Windrowed
- Recycled Mix Placed by Paver with Vibratory Screed
- Mat Compacted
- Surface Applied
  - **Such as NovaChip, Ralumac, Polymer Chip Seal, Thin HMA overlays, etc.**

# The Process

RESTORE HIR SYSTEM

## Continuous with Self-Contained Train



# The Process

RESTORE HIR SYSTEM

Surface Heated to Approximately 250°F



# The Process

RESTORE HIR SYSTEM

➤ First Heater Unit





# The Process

RESTORE HIR SYSTEM

- Second Unit:  
- Heater Unit  
and First  
Milling  
Section

08.16.2006 13:00

# The Process

RESTORE HIR SYSTEM

- Second Unit: Combination - Heater Unit and First Milling Section
- Highlight of Milling



# The Process

RESTORE HIR SYSTEM



➔ Heated,  
Milled  
Windrow  
Going  
Through  
Tunnel  
Heaters

# The Process

RESTORE HIR SYSTEM



➔ Third Heater Unit

# The Process

RESTORE HIR SYSTEM



- Fourth Unit:  
– Heater Unit  
and Second  
Milling  
Section
- Highlight of  
Deeper  
Milling

# The Process

RESTORE HIR SYSTEM



- Fourth Unit: Combination – Heater Unit and Second Milling Section
- Highlight of “Windrow”

# The Process

RESTORE HIR SYSTEM



↘ Fifth  
Heater  
Unit

# The Process

RESTORE HIR SYSTEM



- Sixth Unit:  
– Heater Unit  
and Third  
Milling  
Section
- Highlight of  
“Emulsion  
Injection”
- Engineered  
Emulsion  
Metered at  
Design  
Content



# The Process

RESTORE HIR SYSTEM

- ↘ Sixth Unit:  
Combination –  
Heater Unit and  
Third Milling  
Section
- ↘ Highlight of  
“Windrow  
and Product  
Ready for  
Paving”

08.16.2006 14:08

# The Process

RESTORE HIR SYSTEM

↘ Side view of  
“Wind Row”



# The Process

RESTORE HIR SYSTEM



➔ Windrow  
and Windrow  
Elevator

# The Process

RESTORE HIR SYSTEM



➔ Windrow  
Elevator &  
Paver

# The Process

RESTORE HIR SYSTEM



➔ Recycled Asphalt Mix Placed with Paver and Vibratory Screed

# The Process



- ◆ Recycled Mat Being Rolled

# The Process

RESTORE HIR SYSTEM

- Temperature Reading of Pre-Compacted Mat
- Minimum Temperature of 190°



08.16.2006 13:52

# Finished Mat



- ◆ Side by Side with adjacent lane



# Finished Mat

RESTORE HIR SYSTEM

➔ Compacted and Finished Product

08.16.2006 14:18

# Finished Mat

RESTORE HIR SYSTEM



➔ Compacted and Finished Product

# Benefits

RESTORE HIR SYSTEM

## ❑ Aged, Distressed Surfaces Replaced with New Surfaces

- Deformations Leveled
- Surface Cracking Removed
- Clearances, Curb Heights Maintained
- Reuses Existing Materials
- Can, Itself, be Recycled



# Benefits (Continued)

RESTORE HIR SYSTEM

- ❑ Minimizes Lane Closure Time
- ❑ Other Lanes Remain Open During Construction
- ❑ Quick Return to Traffic



# Benefits (Continued)

RESTORE HIR SYSTEM

- ❑ Rejuvenates Aged, Oxidized Asphalt
- ❑ Excellent Aggregate/RAP Coating
- ❑ Polymer Improves
  - Flexibility & Durability
  - Adhesion
  - Temperature Susceptibility
  - Strength & Rutting Resistance
  - Cracking Resistance



# Side-by-Side Trial After 2 Winters

**K-170  
Reading, KS  
Construction  
HIR +  
1" HMA  
overlay**



***HIR with  
Engineered  
Emulsion***



***HIR with  
Conventional  
Emulsion***

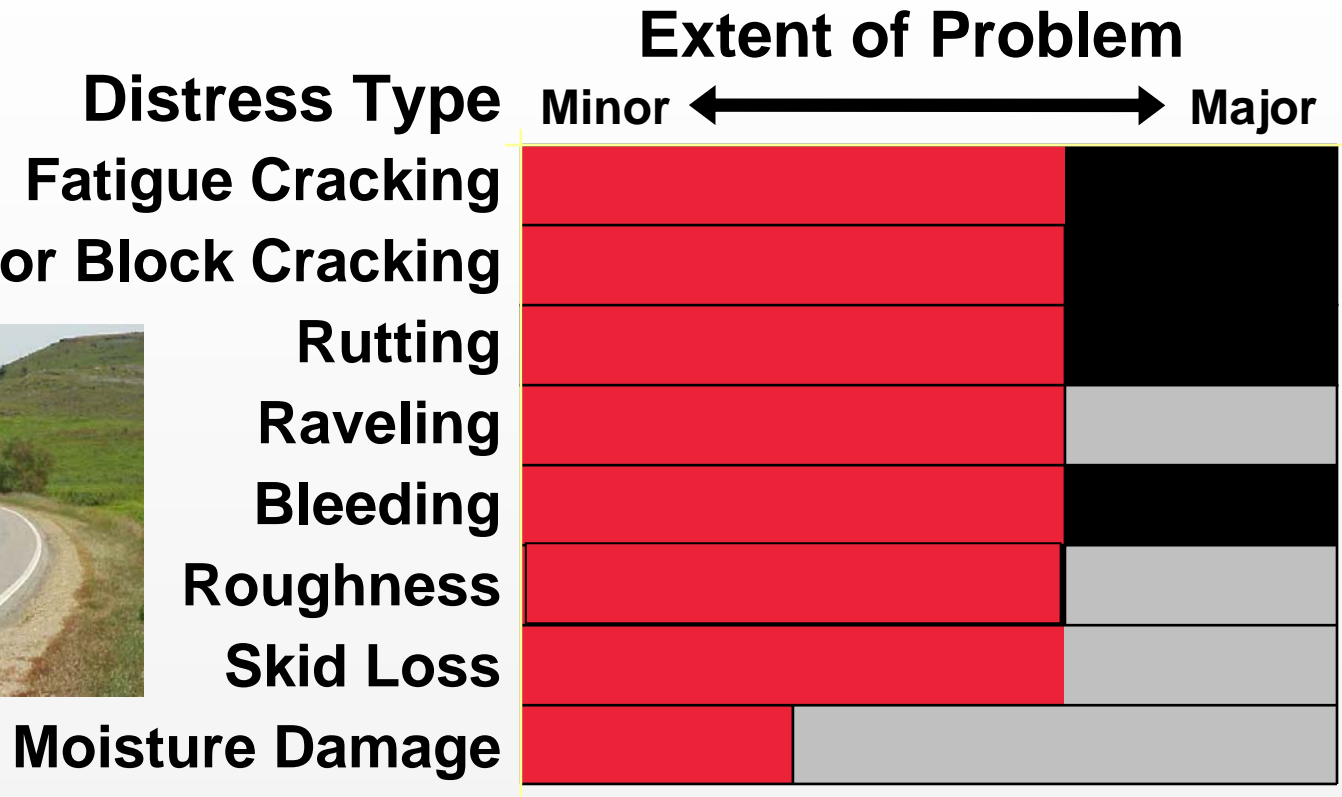
# Where Can RESTORE HIR be Used?

- ❑ Highways, City Streets, Country Roads
- ❑ Materials that aren't Stripping Sensitive
- ❑ Structurally Sound Pavements
- ❑ Distressed Surfaces
- ❑ Good Drainage



# Cold and HIR Recycling

## Allowable Pavement Condition



Effective

Marginal

No Impact

Not Appropriate



# US-281 Osborne, Co



# US-281 Osborne, Co



# US-56 McPherson, Co



# K - 156 Pawnee County



# K - 28 Cloud/Jewell Co



# US-54 Meade/Seward



# US-59 Jefferson Co



# Oklahoma - Turner Turnpike Tulsa to OKC



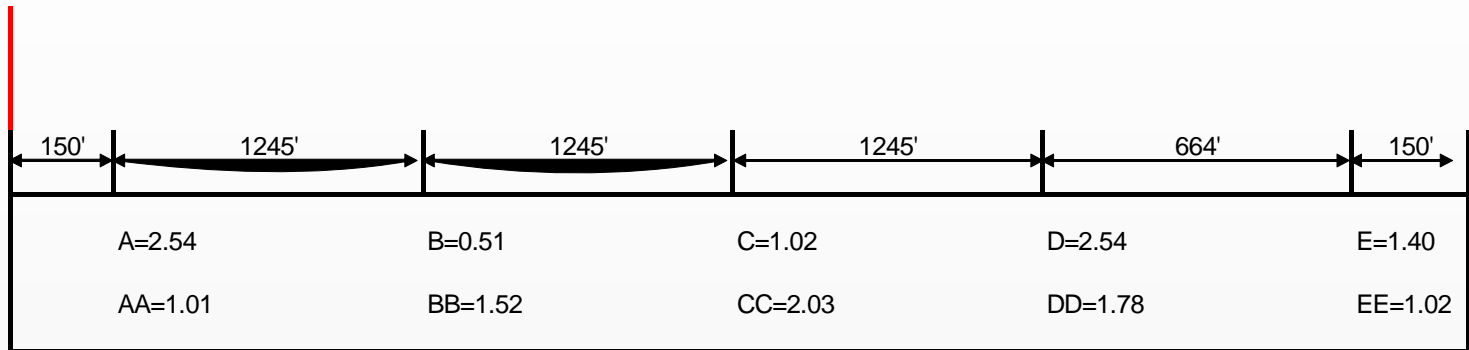


# Project Details

- ◆ **Constructed July 17, 2006**
  - WB driving lane
  - 1 mile in length
  - Near Stroud, OK toll booth
- ◆ **Open to traffic 28 days after recycling**
  - 335,000 vehicles (total WB)
  - 13,000 ADT
  - +/- 126,000 ESALs
- ◆ **Surfaced with Bonded Wearing Course**

# Rut Depth Measurements

Mile Marker 194  
Westbound Outside Lane



\*\*\*Each Rut was measured within the wheel path; approximately 3' off the centerline and 3' off the outside edge of pavement

Rut Depths	mm
A	2.54
AA	1.01
B	0.51
BB	1.52
C	1.02
CC	2.03
D	2.54
DD	1.78
E	1.40
EE	1.02
<b>Average Rut Depth</b>	<b>1.54</b>

**Maximum Rut Depth  
(0.1 inch)**

**Average Rut Depth  
(0.06 inch)**

# High Temperatures While Open to Traffic

## High Temperatures Stroud, OK\* July 18 to August 12, 2006

<b>JULY</b>			<b>AUGUST</b>		
	18	100		1	98
	19	102		2	100
	20	102		3	98
	21	100		4	98
	22	89		5	100
	23	87		6	102
	24	91		7	96
	25	98		8	98
	26	96		9	102
	27	96		10	104
	28	96		11	89
	29	96		12	100
	30	98			
	31	98			

Average temperature = 97.5°F

\*Source: [www.wunderground.com](http://www.wunderground.com)

# Summary

RESTORE HIR SYSTEM

## ❑ Engineered Hot In-Place Recycling

- Cost-Effective
- Quick
- Durable
- Reuses Existing Materials



# Thank you.

## Questions?

