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Hot In-Place Recycling

Ron Wilson
with Dustrol, Inc.
Towanda, KS

In-Place Recycling & Reclaiming Seminar | Dickinson, ND | June 27-28, 2017

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Introduction to Asphalt Recycling

- HIR – The Process
- Project Selection
- Candidates
- Asphalt Recycling Methods
- Surface Recycling Benefits
- Additives-Mix Design
- Factors that cause success/failures
- Q&A

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The Bottom Line Question

How can I maximize the return on my investment in asphalt pavement rehabilitation funding?

By repairing your asphalt pavement during the first 40% drop in quality.

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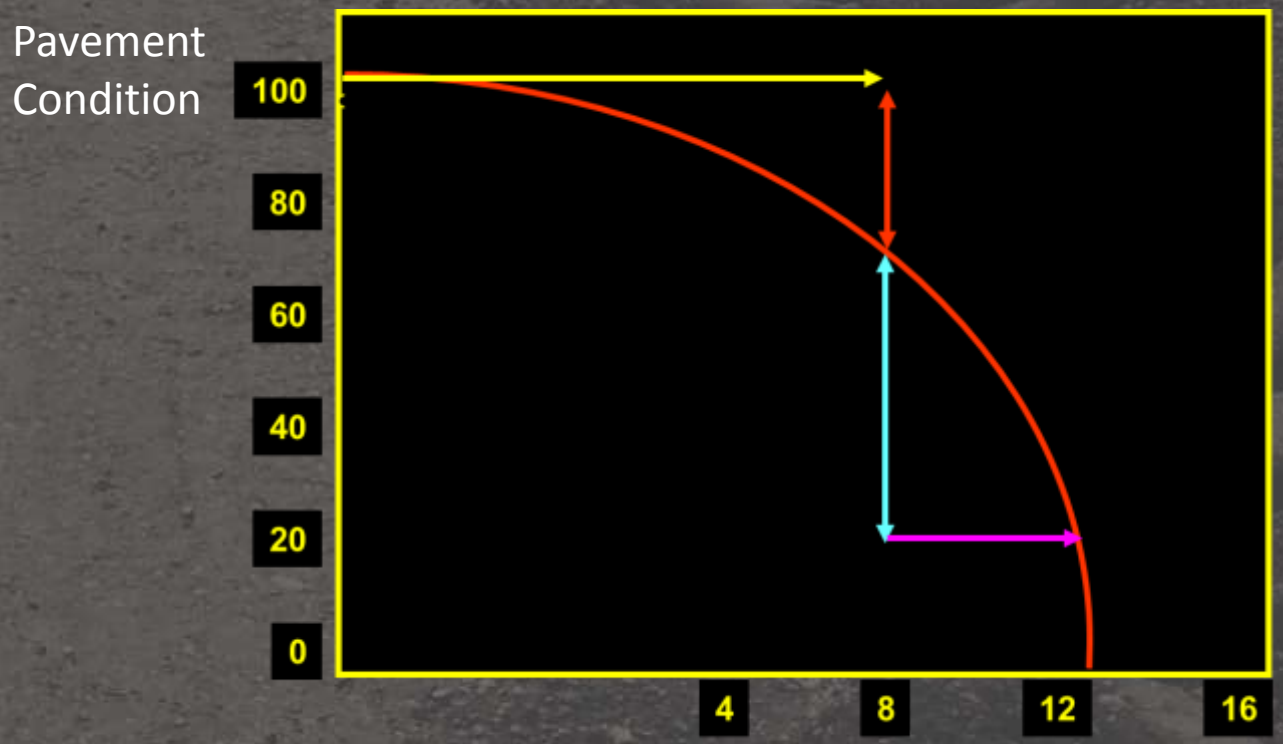
The Savings of Timely Maintenance



Each $1 spent during the first 40% drop in quality will cost $4-5 if delayed until pavement loses 80% of its original quality.

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Hot In-Place Recycling

What is HIR?

Benefits of HIR

Different types of HIR

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ASPHALT
100% RECYCLABLE
"IN-PLACE"

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What is Hot In-Place Recycling?

Hot In-Place Recycling (**HIR**) is an on-site, in place, pavement rehabilitation method that consists of heating, scarifying/milling, softening, mixing, placing and recompacting the existing bituminous pavement. The HIR process may incorporate recycling agents, polymer modifiers, virgin aggregates, and/or new hot mix asphalt to create a newly recycled mix. The HIR process can be left to stand-alone without the need for a surface treatment. It can have an integral overlay added on top of the newly recycled pavement, or may have a surface treatment added at a later date. Hot In-Place Recycling is the oldest of the asphalt recycling disciplines and has evolved into three main technologies.

The three sub-categories of HIR are:

- Surface Recycling
- Repaving
- Remixing

Hot In-Place Recycling is a cost-effective, flexible pavement rehabilitation method that can effectively address the classic symptoms of asphalt pavement deterioration. In a period of rapidly increasing costs and limited funding, HIR gives the opportunity to spread available dollars over a much greater area while saving our precious natural resources.

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HIR Benefits

- Repairs Surface Distress
- Extends Life
- Improves Ride Quality
- Eliminate need for a leveling course
- Environmentally friendly
- Cost savings

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More Recycling Benefits

Aged, distressed
surfaces replaced
with like new surfaces

- Deformations leveled
- Surface cracking removed
- Crowns re-established
- Clearances, curb/shoulder heights maintained
- Reuses existing paid for materials
- Can, itself, be recycled

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The Surface is the Critical Area

Aging of asphalt pavement occurs most rapidly at the surface

Surface Defects

- Ruts, Shoves & Bumps
- Patches & Utility Cuts
- Reflective & Shrinkage Cracks
- Weathering, Bleeding & Raveling
- Pavement Geometry

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Where can HIR be Used?

- Highways, city streets, country roads
- Structurally sound pavements
- Distressed surfaces
- Good drainage

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Candidates good and bad

Thermal Cracking

Pre Patched

Fatigue Cracking

No Base Problems

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Excess Tire Rubber

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HIR Project Considerations

- Uniformity
- Depth of existing HMA
- Presence of Chip Seals, can be addressed by premilling/mixing
- Asphalt properties
- Traffic
- Types of pavement distress

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Hot In-Place Recycling

- Treats surface to a depth up to 3 inches
- Allows several different surface treatments to be added during or after the HIR process
- Adds additional binder/modifier
- Adds additional hot mix asphalt/ aggregate

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The 3 Types of HIR

Surface Recycling:

- Heating, reworking and rejuvenating the top one to three inch of an existing asphalt pavement in preparation of either a seal coat, micro-surfacing or overlay

Repaving:

- Heating, reworking and rejuvenating the top one inch of an existing asphalt pavement and simultaneously applying an overlay while the temperature of the recycled layer is 200°F

Remixing:

- Heating, reworking and rejuvenating the top 1 to 2 inches of an existing asphalt pavement adding virgin aggregate and/or admix and mixing the newly recycled material in a pugmill or drum mixing plant prior to laying, either as a binder or surface course

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Repaving

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Repaving

1. Heating the existing pavement

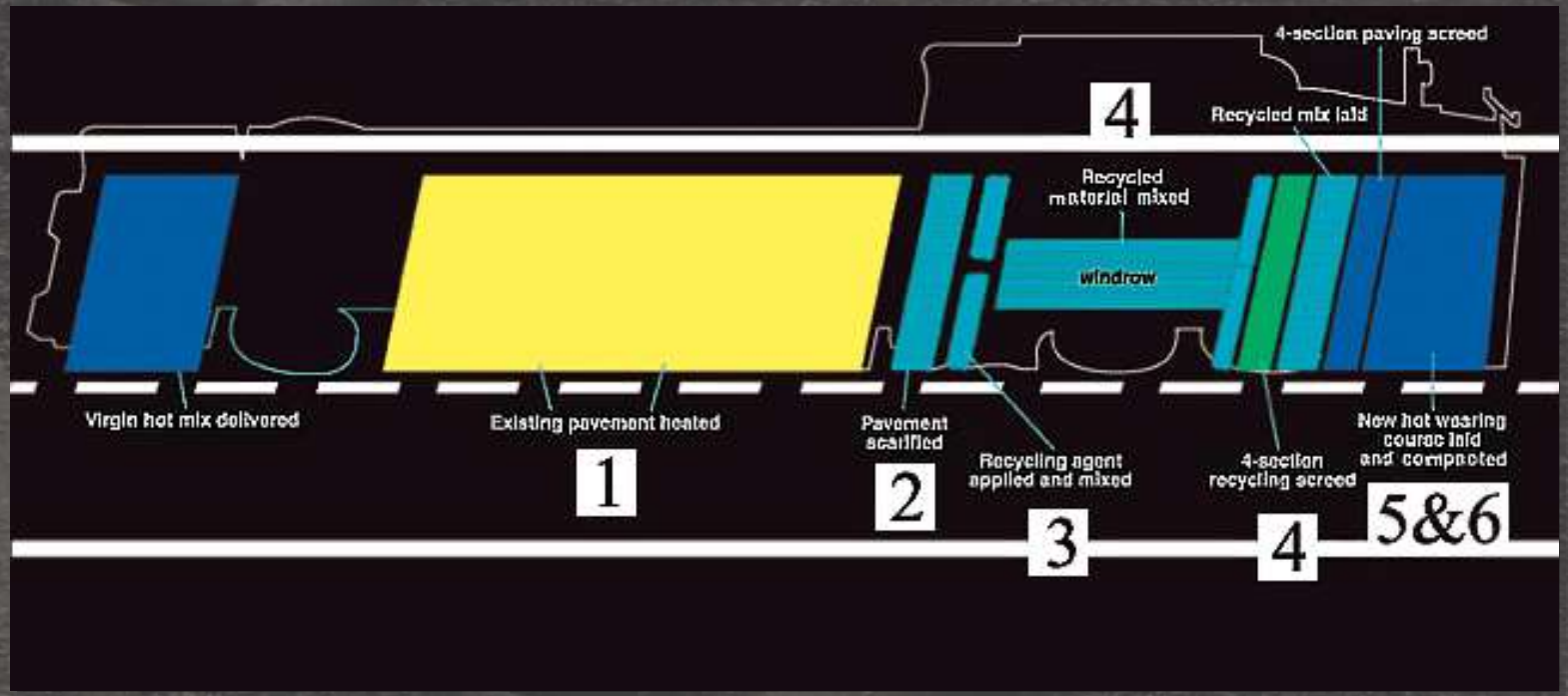
2. Scarifying the heated, softened pavement to a one inch depth

3. Applying a recycling agent to the scarified material to restore viscosity of the aged asphalt

4. Mixing and laying the recycled material to form a leveling course

5. Applying the virgin hot mix while the temperature of the recycled mix is still 225° F

6. Final compaction



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Pre Heater Unit

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Heating Edge Ensures Joint Density

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Repaver Unit

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Repaving Using Multiple Heaters

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Adding Emulsion

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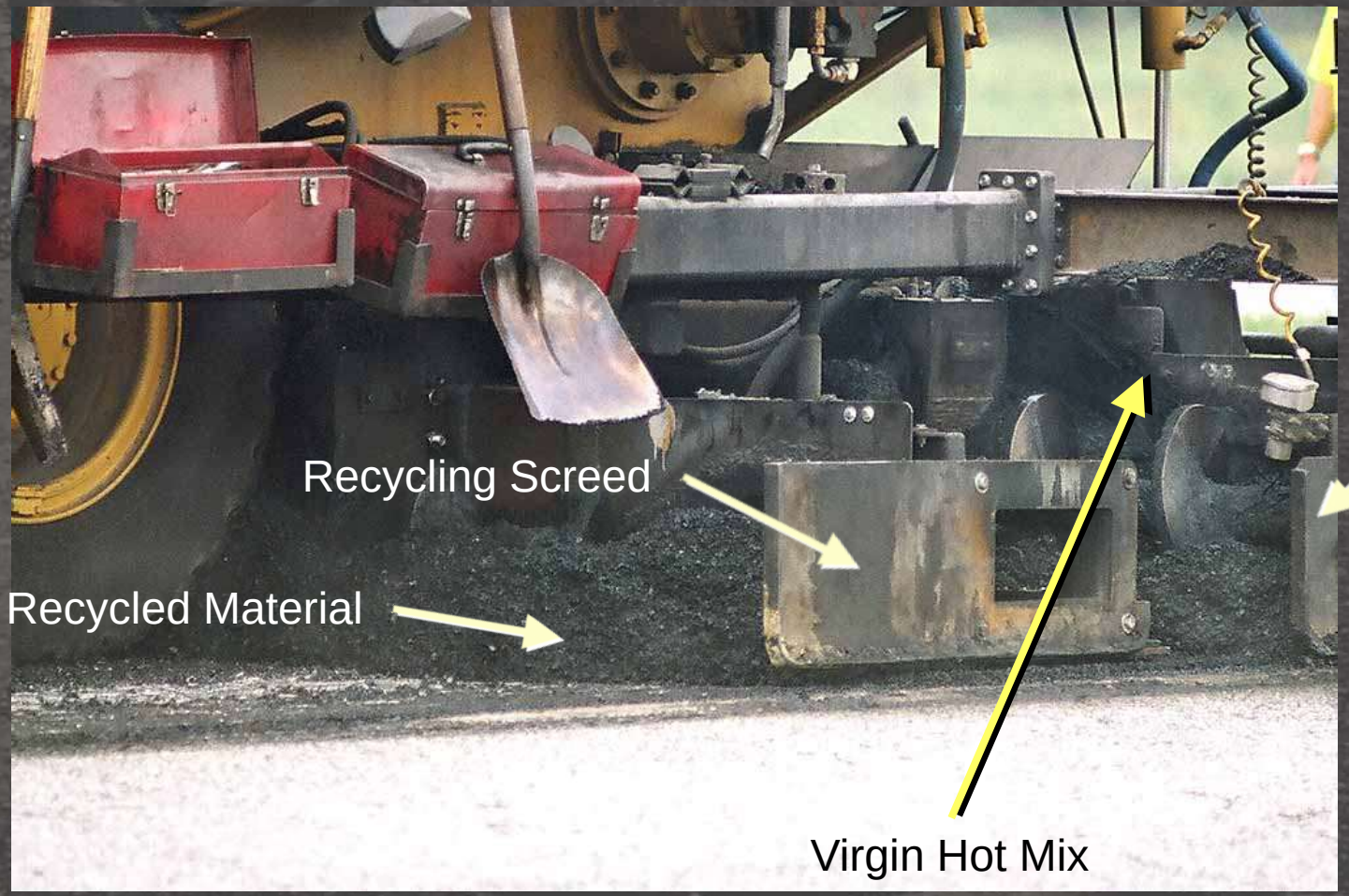
Repaving Screeds



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Repaving

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Remixing

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Remixing

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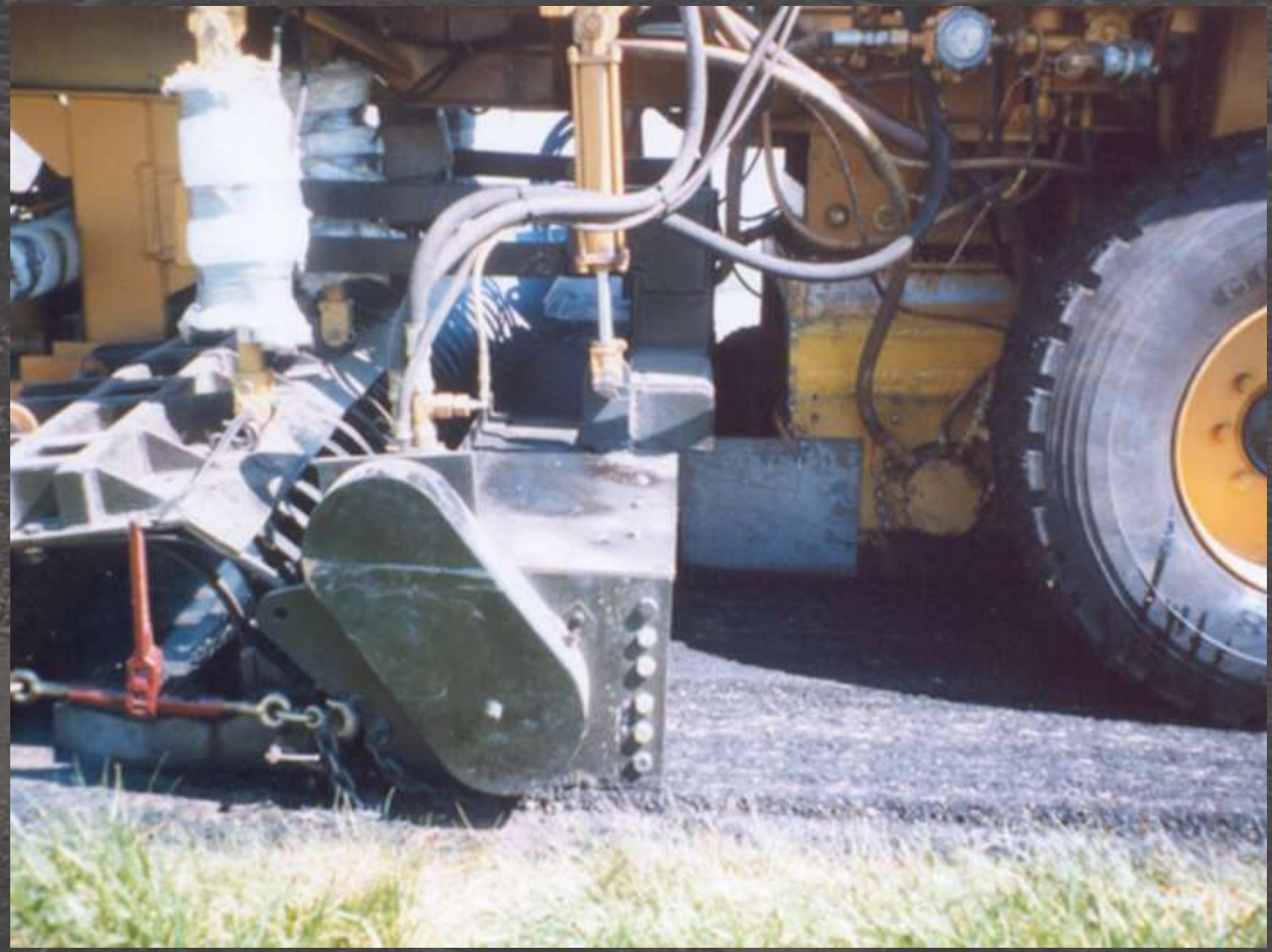
Remixing



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Remixing

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Surface Recycling

Surface Recycling has two different types of processes

- Scarification
- Hot Milling

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Urban Work

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Hot Air

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Heater Scarification

Continuous process with self-contained train

- Surface heated to approximately 300°F
- Softened pavement scarified to depth of 1 - 1½”
- Engineered emulsion metered at design content
- Softened surface & emulsion milled & mixed
- Recycled mix placed by paver with vibratory screed
- Mat compacted
- Surface applied, if needed
  - Such as bonded wearing course, micro-surfacing, high performance chip seal, chip seals, thin HMA overlays, etc.

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Scarification Process

- Surface is heated to approximately 300°F

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Scarification Process

- Softened pavement is scarified to depth of 1” to 1 ½”

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Scarification Process

Emulsion is added after Scarification and mixed with a specialized paver before being laid with a conventional screed.

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Scarification Process

The mat is then compacted with conventional rollers

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Hot Milling

- 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 UBAWS, Micro, Polymer Chip Seal, Thin HMA overlays, etc.

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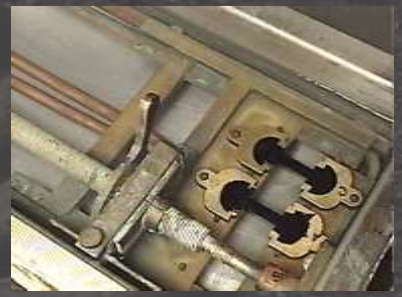
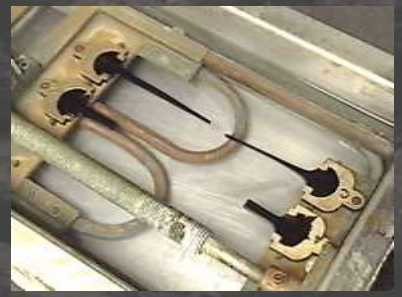
Engineered HIR Recycling Emulsion

- 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
  - Experimenting with warm-mix additive





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Performance Related Specifications

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

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The Design Process

- ❑Engineered Design Formulated for Process
  - ➢ Polymer Modified AC Base
  - ➢ Rejuvenating Oils
  - ➢ Dictated by Performance Based Mix Design
- ❑Hot In-Place Recycling of up to 2 ½” of Existing Surface
- ❑Final Surfacing Dictated by Traffic & Road Conditions

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First Heater Unit

The MARS process begins with a Preheating unit

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First Milling Heater

Next is the first milling heater which will continue to heat the roadway and remove the first lift of material and windrow it. Depending on the material it will remove ½” to 1” of material.

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Windrow

The material is windrowed to expose the next lift of material for heating.

Special Tunnel heaters are used to allow the windrow to enter the heaters ovens. There the underlying asphalt is heated and the windrow is kept at temperature.

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Heating Units

One or two more sets of Preheaters and Milling heaters with Tunnel ovens will be used to remove the existing asphalt in lifts to maintain heat.

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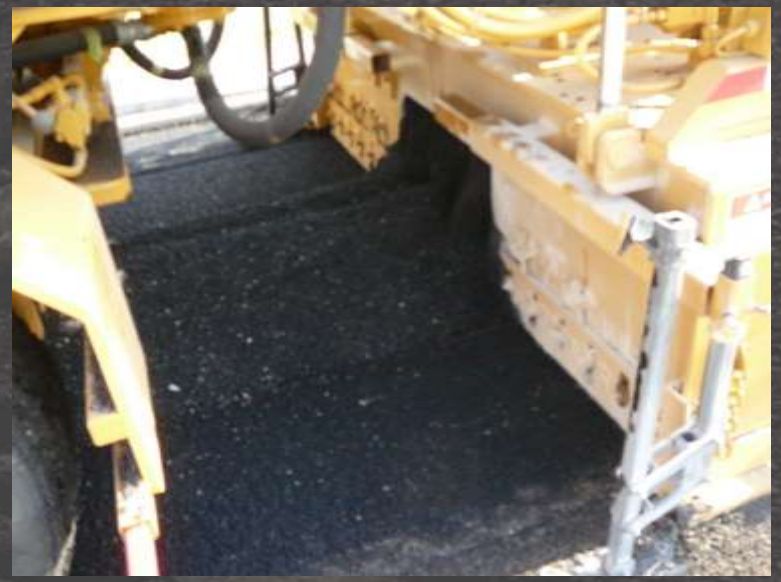
Oiler Milling Heater

The last set of heating units is another tunnel heater followed by a milling heater with an emulsion system on board.

The last milling heater will remove the last lift of asphalt down to the desired depth and inject the emulsion in the milling drum.



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Emulsion Metering System

The metering system adds the emulsion based upon the mix design using a Mass Flow Meter.

Emulsion is added to the heated asphalt.

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Final Windrow

After the emulsion has been added the windrow is picked up by a conventional elevator.

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Roadmix Paver

Dustrol uses a paver equipped with two counter-rotating augers that re-blend the material as it is delivered to the screed. This significantly helps reduce segregation of material.

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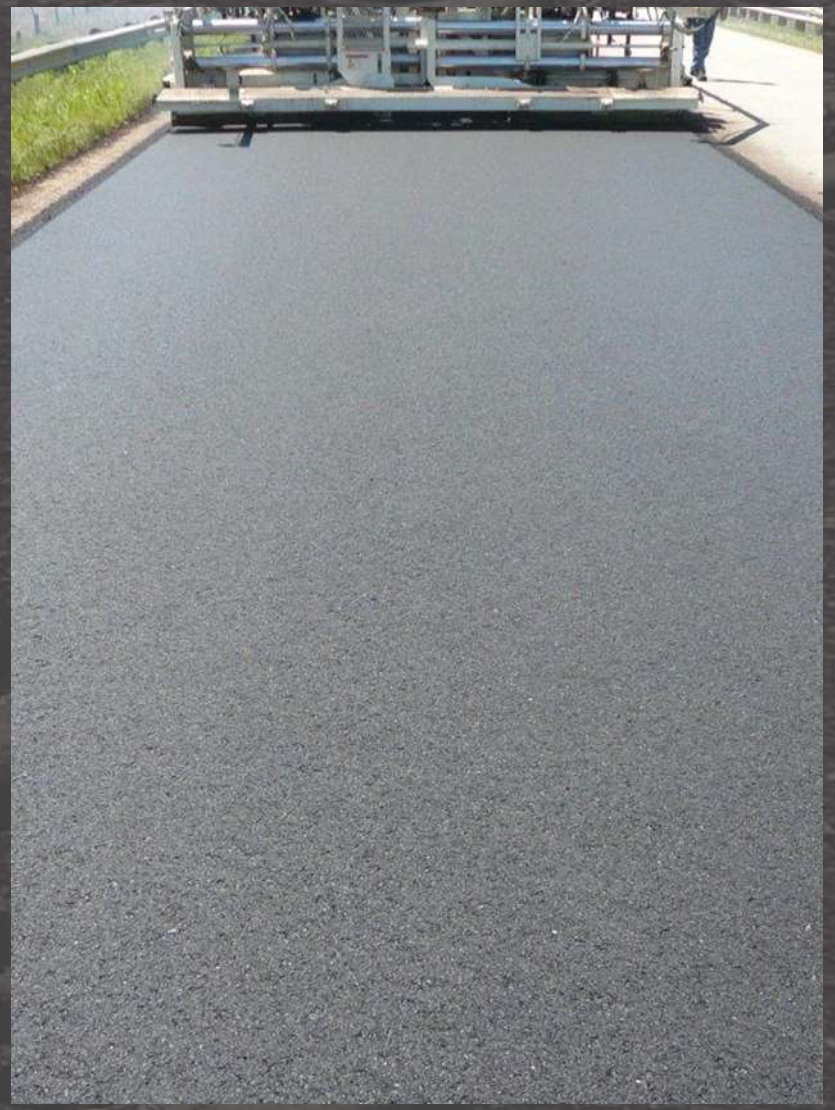
Paver

The recycled asphalt mix is then placed with the paver with a vibratory screed.



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Compaction

The recycled mat is then compacted

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Oscillating Compaction

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Side by Side

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Project Selection

- Can address 10’-16’ wide pavement
- Avoid ramps and shoulders/can be done but not cost effective
- Projects in excess of 100,000 SY most economical (production = 2.5 to 3.5 lane miles/day)
- Excess base failures, full depth PCC patches, utilities may require alternative treatment prior to recycling
- Need 4” of HMA over solid base material or 4” to 5” over existing concrete

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HIR Benefits

- Rejuvenates aged, oxidized asphalt
- Excellent aggregate/RAP coating
- Polymer improves
  - flexibility & durability
  - adhesion
  - temperature susceptibility
  - strength & rutting resistance
  - cracking resistance

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HIR Benefits

- Minimizes lane closure time
- Other lanes open during construction
- Quick traffic return

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HIR Surface Treatments

Chip Seal

Slurry Seal

Mastic Seal

Micro-Surfacing

Hot or Cold Mix Overlay

Ultra-Thin Bonded Overlay

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Material Advances

- High Penetration Asphalt Rejuvenators can be added to bring the aged, stiff bitumen liquid in the mix back to life. Experimenting with warm mix additives to enhance performance
- New hot mix asphalt or virgin aggregate specially designed for the individual project, can be added as required to improve quality.
- Chip seals, micro surface, slurry seals, nova chip or thin overlays can be added during or after completion of the hot in place recycling process.

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Side by Side Trial After 2 Winters

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

HIR with Engineered Emulsion

HIR with Conventional Emulsion

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Summary

Engineering Hot In-Place Recycling

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

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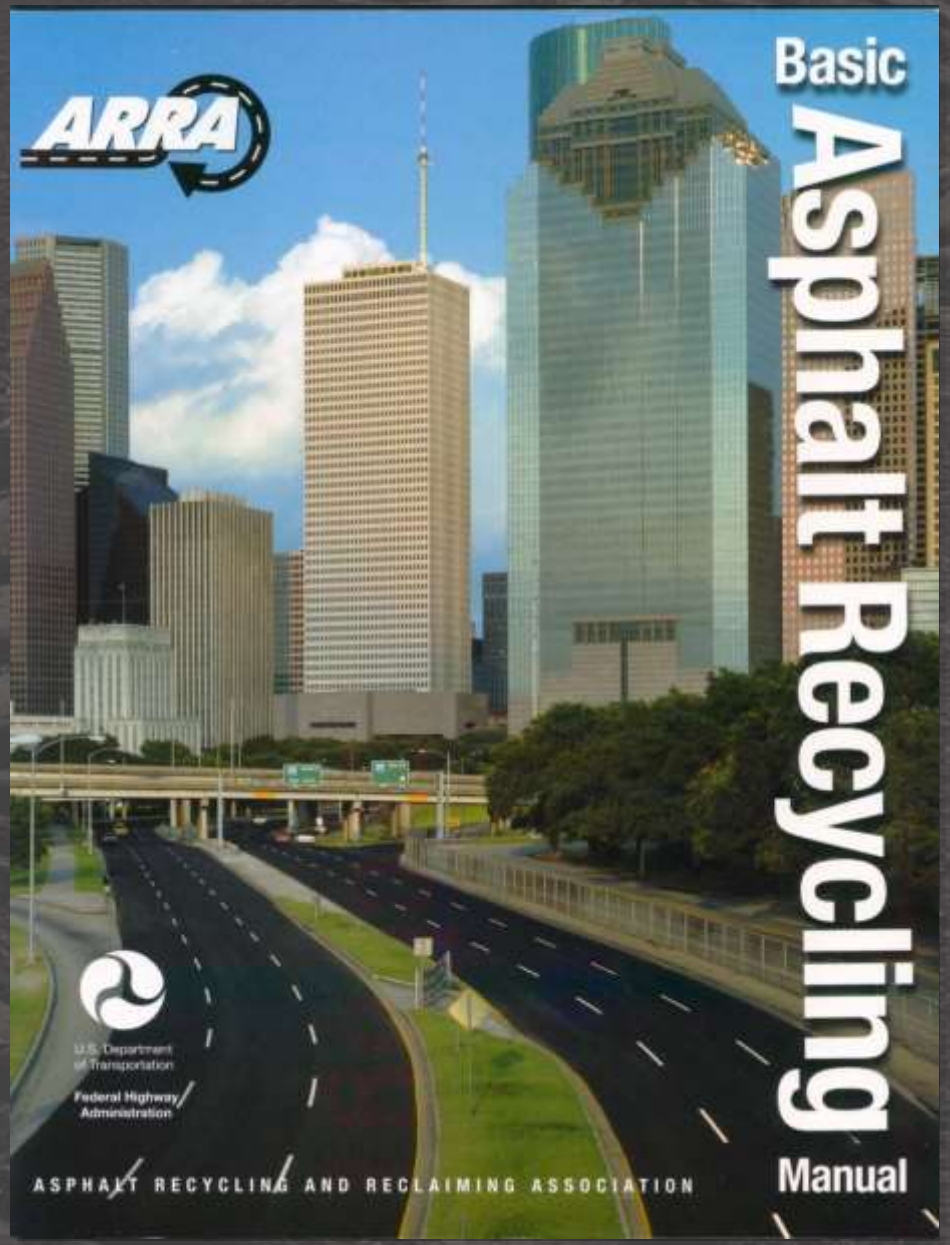
BARM



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Questions?

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