Pavement Preservation
Using
HOT-IN-PLACE RECYCLING

Presented by:

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Who is WJH Engineering and Construction Services?

- Founded in 2009 by W. J. Hoppe PE
  - Retired Navy Civil Engineer Corps Officer
  - Retired City Engineer, City of Mequon WI.
- A small LLC focused on providing municipal engineering services comprised of:
  - Pavement evaluation, preservation, and management
  - Sanitary Sewer
  - Storm Water management
  - DOT and DNR liaison
  - Consultant and Construction contract management
  - Grant writing
- Serve as Gallagher Asphalt Corporations' Wisconsin Representative for their Hot in Place Asphalt Recycling processes.

PAVEMENT MANAGEMENT

A systematic and objective process of managing, planning, and accomplishing the maintenance and repair of a network of roadways, in order to optimize pavement conditions over the entire network. Pavement management incorporates life cycle costs into a systematic approach of minor to major road maintenance and reconstruction projects. The needs of the entire network as well as budget projections are considered before projects are executed. Pavement management encompasses the many aspects and tasks needed to maintain a quality pavement inventory, and ensure that the overall condition of the road network can be sustained at desired levels. A pavement management system is typically a computer program that models pavement and surface deterioration due to traffic and weather, and recommends various ***Pavement Preservation*** practices / techniques, maintenance and repairs to the road surface based on various tests, conditions, and future requirements.

Pavement Preservation

The term *"Pavement Preservation"* involves the implementation of programs and activities employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety, and meet road user expectations".

The cumulative effect of systematic, successive preservation treatments is to postpone costly rehabilitation and reconstruction.

Pavement Preservation Components

A Pavement Preservation program consists primarily of three components:

- routine maintenance
- preventive maintenance
- minor rehabilitation (non structural)

Routine Maintenance "consists of work that is planned and performed on a routine basis to maintain and preserve the condition of the highway system or to respond to specific conditions and events that restore the highway system to an adequate level of service." *Source: AASHTO Highway Subcommittee on Maintenance*

- cleaning of roadside ditches and structures: to ensure adequate drainage is maintained
- maintenance of pavement markings
- crack filling: to reduce water infiltration and reinforce adjacent top-down cracks
- pothole patching
- isolated overlays – wedging

Preventive Maintenance is "a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without significantly increasing the structural capacity)." *Source: AASHTO Standing Committee on Highways*

- Crack Filling/Crack Sealing
- Fog Seals
- Slurry Seals
- Scrub Seals
- Microsurfacing
- Chip Seals
- Thin Overlay
- Ultrathin Friction Courses
- Cold Planning / Milling
- Hot in Place Recycling

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Suggested Timing of Pavement Preventive Maintenance Treatment Applications

Treatment	Recommended Year of Initial Treatment	Treatment Timing Cycle
Crack Sealing	1 to 3	Annually
Fog Seals	0 to 3	Annually
Scrub Seals	2 to 6	Annually
Slurry Seals	2 to 6	Annually
Micro-surfacing	3 to 7	2 years
Chip Seals	2 to 5	Annually to 2 years
Ultrathin Friction Course	2 to 6	2 years
Thin Overlays	5 to 8	2 years
Hot in Place Recycling	6 to 10	5 years

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Minor rehabilitation consists of non-structural enhancements made to the existing pavement sections to eliminate age-related, top-down surface cracking that develop in flexible pavements due to environmental and working or load related exposure.

- Cold Planning / Milling
- Hot in Place Recycling
- Cold in Place Recycling

FHWA Recognizes HIR as a Pavement Preservation Technique

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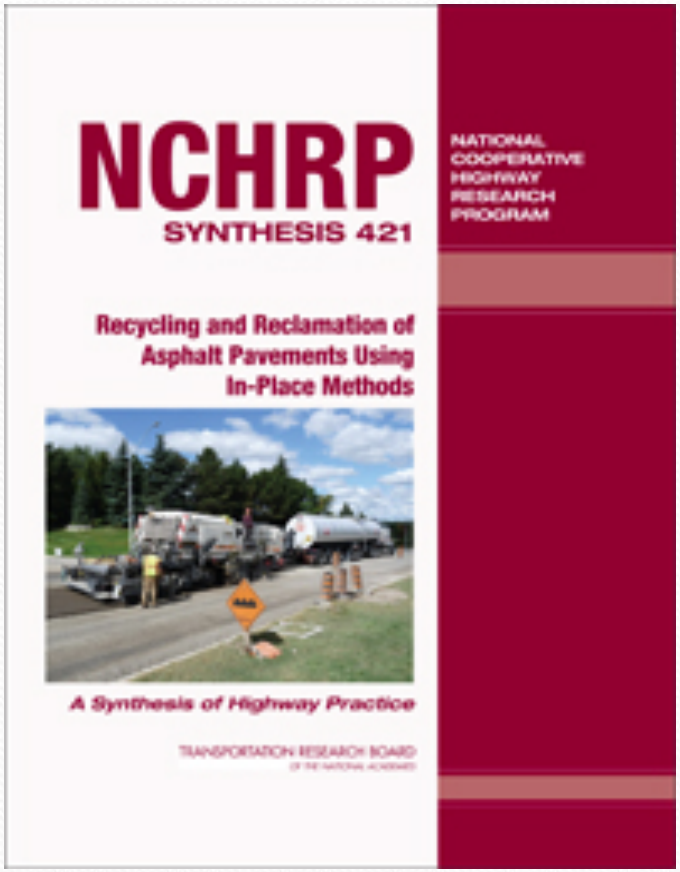
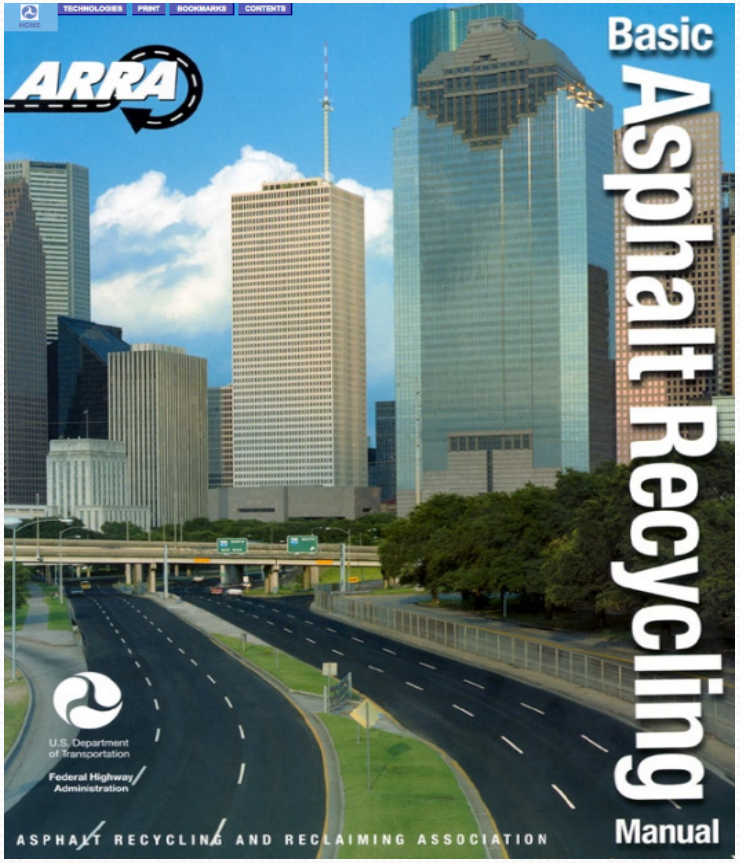

NCHRP
SYNTHESIS 421
NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
Recycling and Reclamation of Asphalt Pavements Using In-Place Methods
A Synthesis of Highway Practice
TRANSPORTATION RESEARCH BOARD


TECHNOLOGIES
PRINT
BOOKMARKS
CONTENTS
ARRA
Basic
Asphalt Recycling
Manual
U.S. Department of Transportation
Federal Highway Administration
ASPHALT RECYCLING AND RECLAIMING ASSOCIATION

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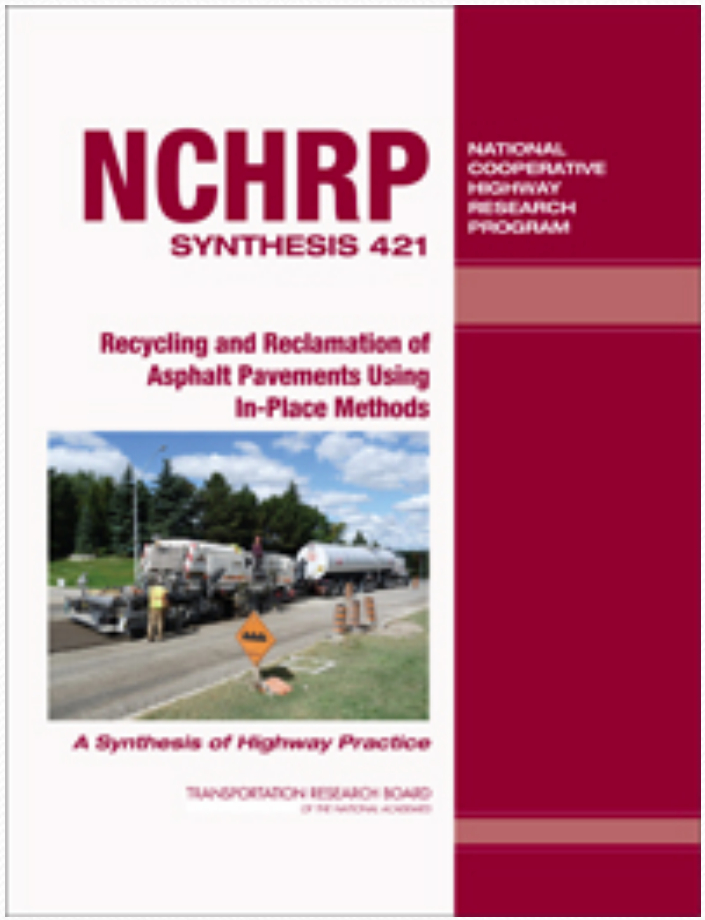

In-Place recycling and reclamation of asphalt pavements provide agencies with the ability to optimize the value of in-place materials, minimize construction time and traffic flow disruptions, and reduce the number of construction vehicles moving in and out of the construction area

Preface by Jon M. Williams
Program Director TRB

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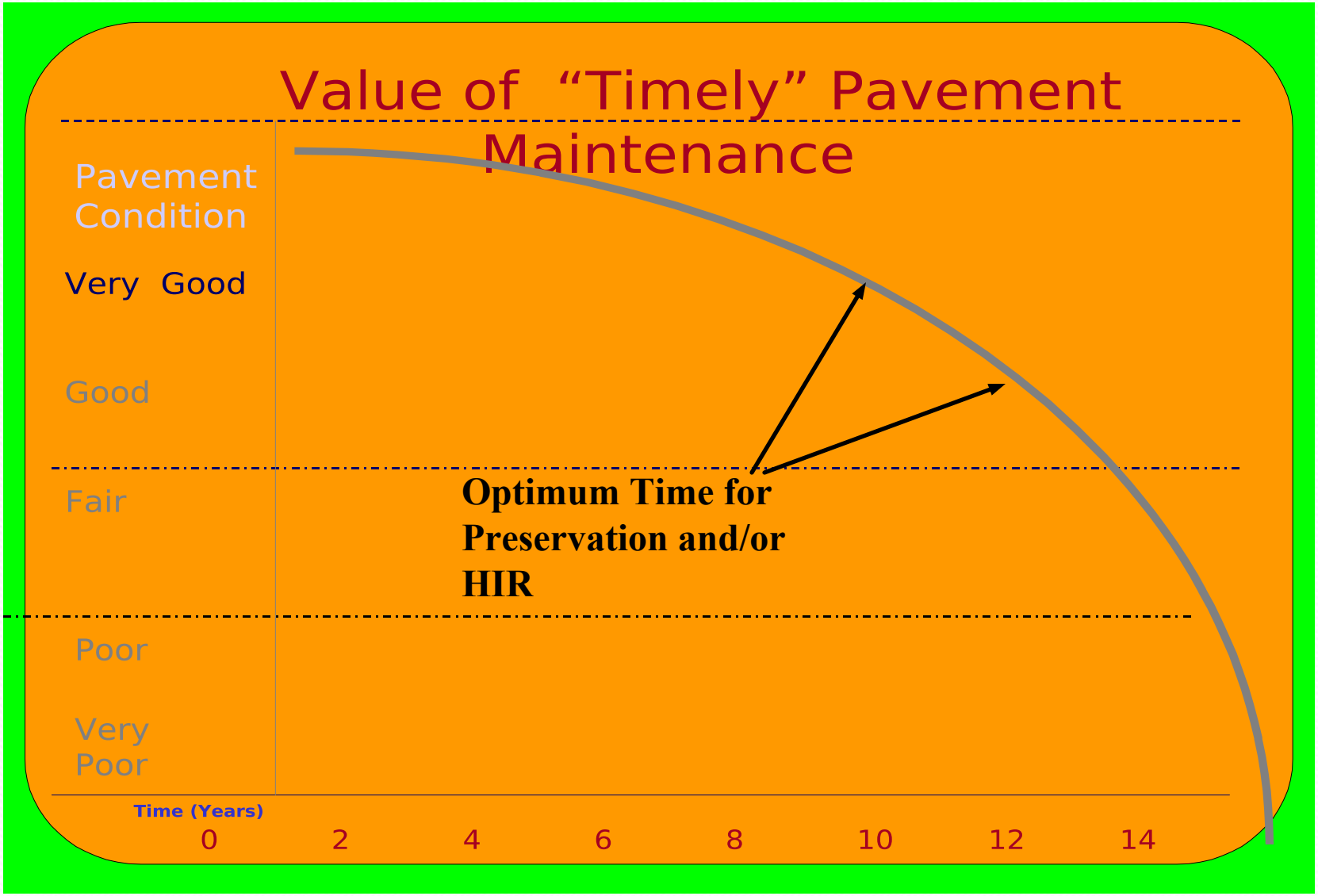
HIR

Where Does It Fit In?

Pavement

Preservation

Value of "Timely" Pavement Maintenance



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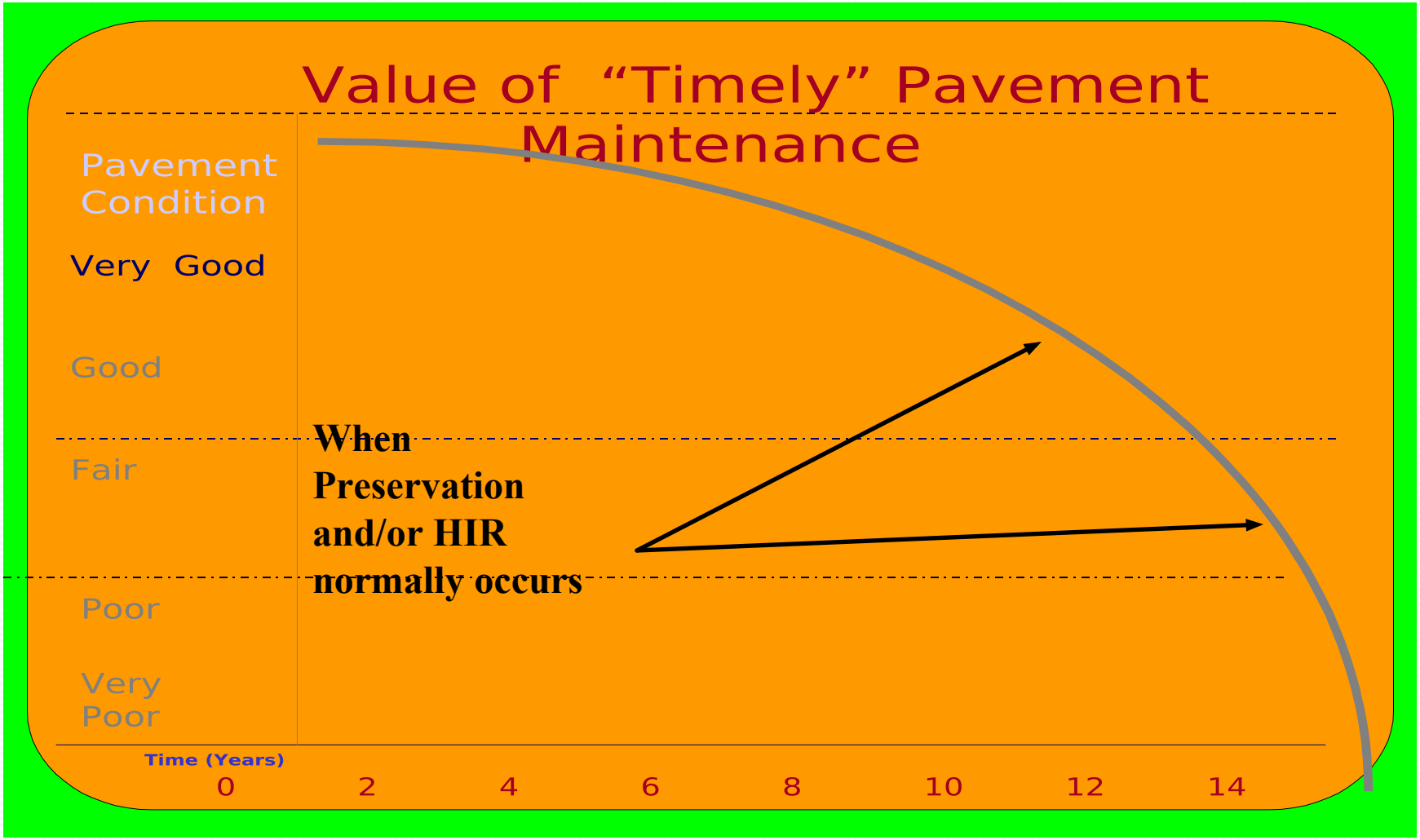
Value of "Timely" Pavement Maintenance



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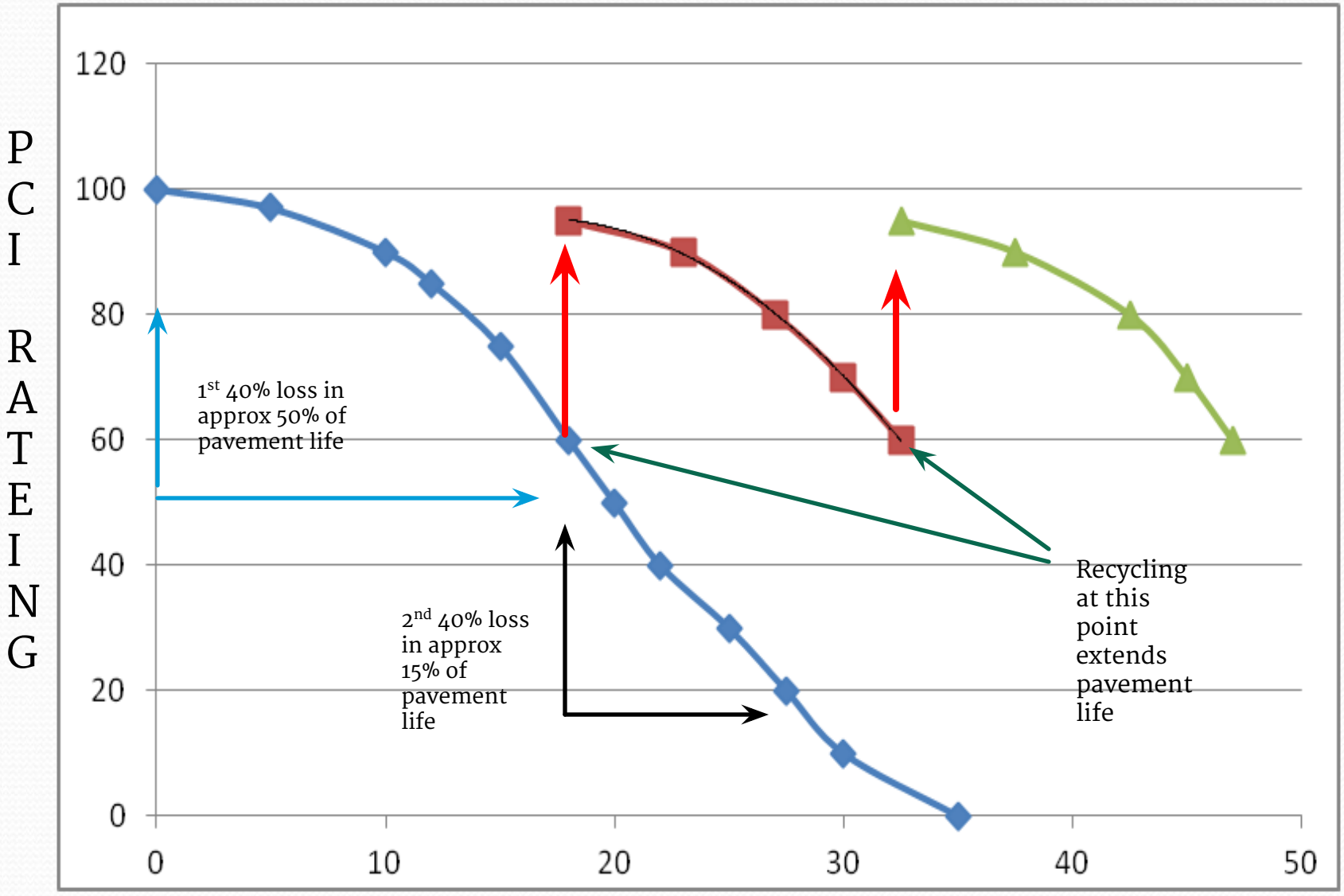
Pavement Preservation Saves $$$

Several studies have shown that it costs highway agencies less if the pavements are kept at a certain acceptable level of serviceability. According to World Bank Sources, each $1.00 spent during the first 40 percent drop in road quality / condition will cost $4.00 to $5.00 if delayed until the pavement loses 80 percent of its original quality


PCI RATEING
120
100
80
60
40
20
0
0
10
20
30
40
50
1st 40% loss in approx 50% of pavement life
2nd 40% loss in approx 15% of pavement life
Recycling at this point extends pavement life
Pavement Life

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Asphalt Recycling and Reclamation Association

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ARRA Recycling Disciplines

- Cold Planning / Milling
- Hot in Place Recycling
- Cold in Place Recycling
- Full Depth Reclamation
- Soil Stabilization

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This is not a new Concept or Process

Heater in Toronto, 1916

Heater in Chicago, 1930

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ARRA Sub-categories within the HIR Discipline

- Remixing
- Surface Repaving
- Surface Recycling (ie. Heater Scarification)

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Remixing Process

- Heating asphalt pavement 37.5-60 mm (1 1/2 to 2.4 inches)
- Scarification / Milling and collection of RAP in windrow
- Add virgin aggregate, recycling agent, or virgin HMA mix
- Mix in a pugmill
- Spread recycled mix and compact

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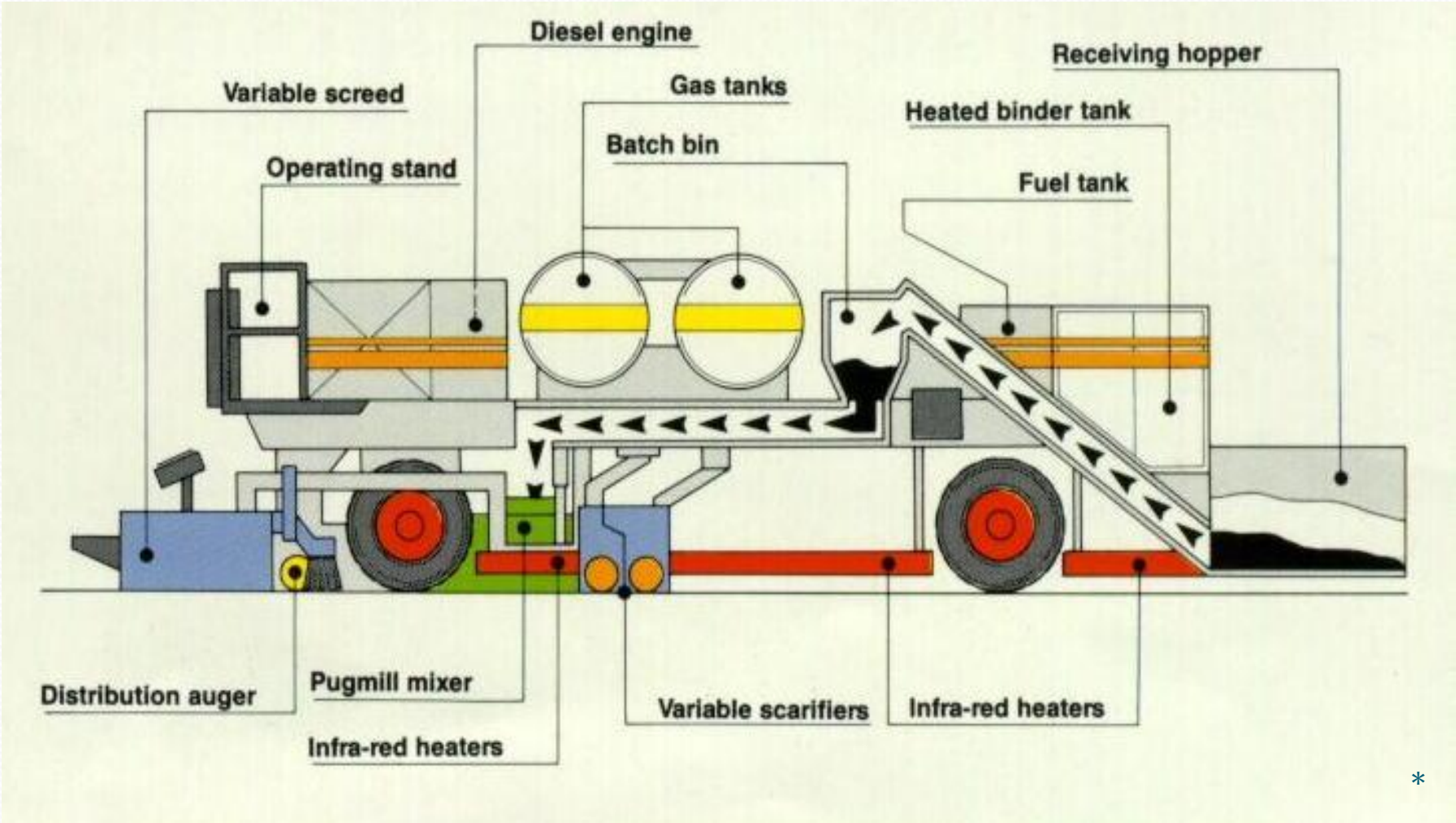
Single Pass Remixing Equipment



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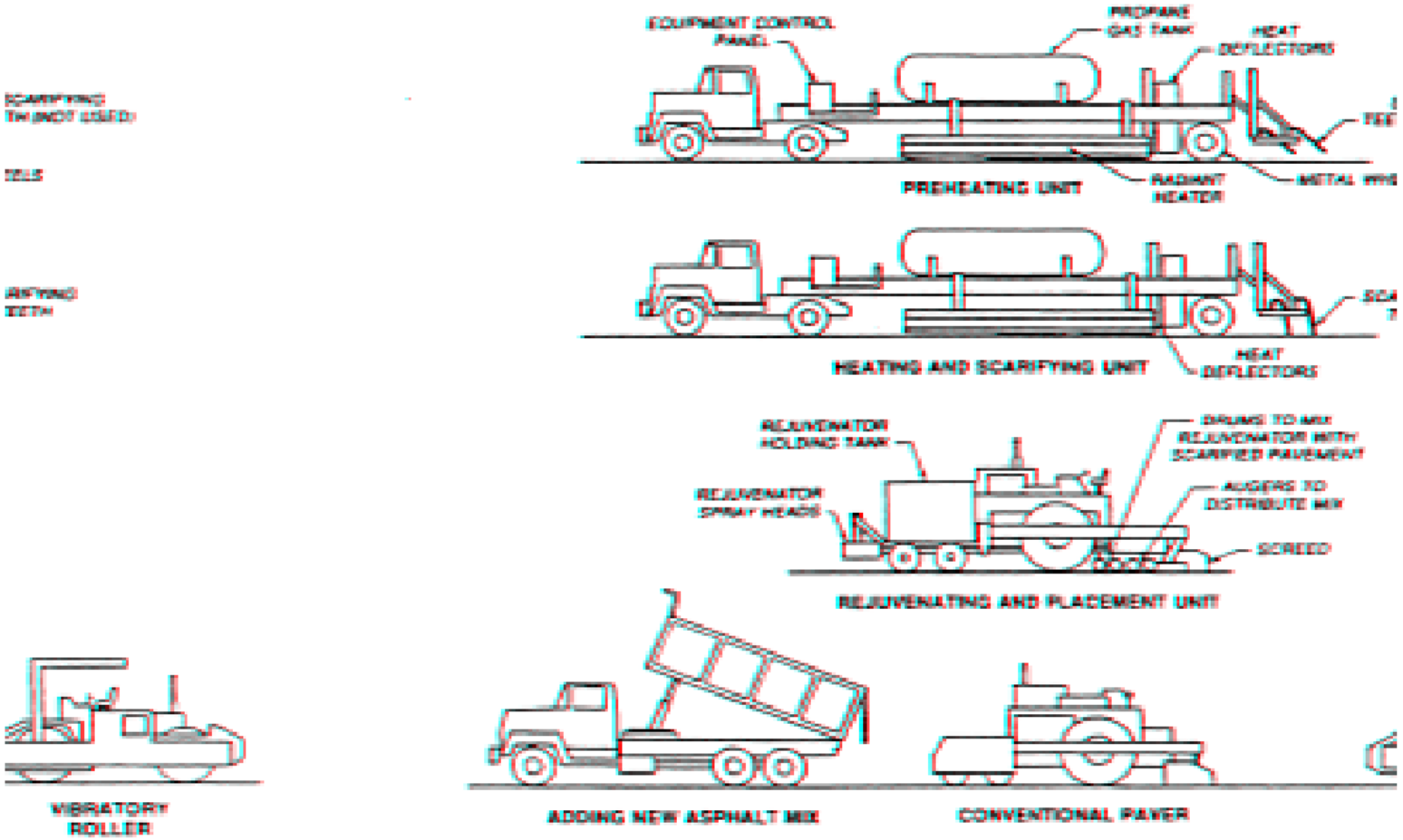
Repaving

- Definition: surface recycling method combined with simultaneous overlay of new HMA to form a thermal bond between recycled and new layers
- Depth: 25 to 50 mm (1 to 2 inches)

Steps in Repaving Process

1. Multiple heating units to soften asphalt surface.
2. Scarify / Milling softened pavement
3. Add and mix recycling agent with RAP
4. Spread the recycled mix with screed
5. Spread the new mix with screed on top of the recycled mix
6. Compact both layers of recycled and new mixes

Schematic of Multiple-Pass Repaving



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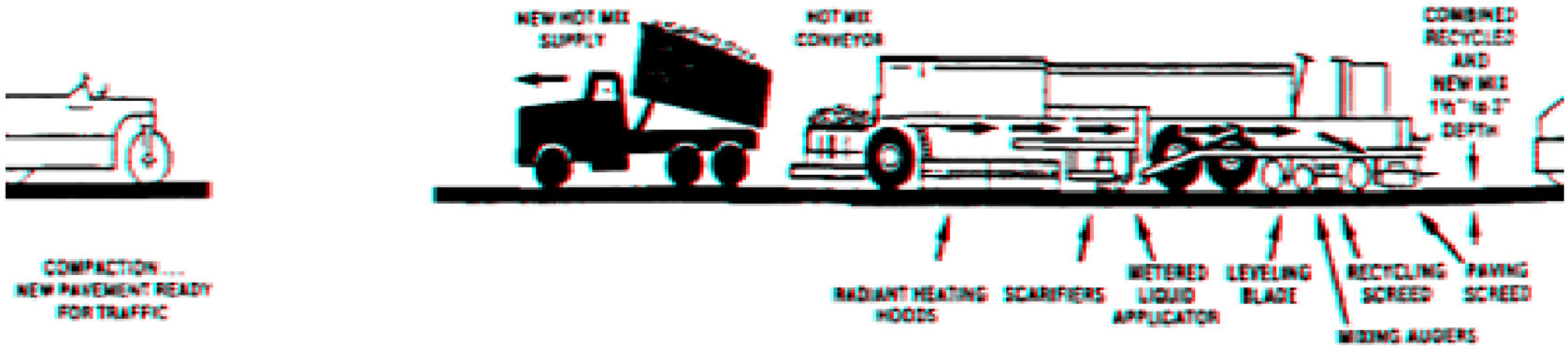
Schematic of Single - Pass Meth



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Local Hot-in-Place Recycling Options:

- Re-HEAT
- Surface Recycling (Heater Scarification)

Re-HEAT

or

Heater- Scarification?

Hot in Place Recycling by the **Heater-Scarification** Method

What is the Hot-in-Place Recycling **Heater-Scarification** Method?

The Heater-Scarification method is an on-site, in place, pavement rehabilitation method that consists of heating existing surface layer of asphalt, applying new oil / emulsion, scarifying (by viscous shearing) the surface layer, mixing, placing to established grade, and re-compacting. The now rejuvenated / recycled bituminous pavement can be opened to traffic.

What are the steps involved with Heater Scarification

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Process Steps for Surface Recycling by Heater- Scarification

1. Clean the road surface with a power broom removing all loose debris and organic material.
2. Pre-Heater takes pavement surface temp to 180 – 200 degrees.
3. A 2nd Heater takes surface pavement temp to 280 – 325 degrees with a heat penetration depth of 4 – 6 inches.
4. Introduction of rejuvenating agent.
5. Spring-loaded tines set hydraulically at prescribed depth scarify (viscously shear) the existing road surface performing the first mix and will drag over existing structures to avoid damage.
6. Full width reversible augers complete the mixing of the hot scarified asphalt and rejuvenating agent.
7. While still at 200 degrees the rejuvenated asphalt is re-laid to original cross slope and grade. Minor re-profiling with standard paving screed can be accomplished.
8. Compaction
9. Open to traffic
10. The now re-plasticized asphalt is ready to receive its surface treatment.

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Hot in Place Recycling Re-Heat Method

What is the **Re-HEAT** Method?

Re-HEAT is an on-site, in place, pavement rehabilitation method that consists of **heating** the existing pavement, viscously shearing and **removing** the top surface course(s) into an on-board heated mixing drum, **adding** a hot asphalt rejuvenating oil/emulsion, **mixing** the material uniformly in the on-board heated mixing drum, **re-laying** the recycled material, followed by **compaction**.

Process Steps for Surface Recycling by the Re-HEAT Method

1. The road surface is cleaned with a power broom to remove any loose debris and organic material.

2. The road surface is softened with radiant convection heat

3. A rotary blade system viscously shears and dislodges the heated asphalt material to the prescribed depth for processing.

4. The dislodged, hot asphalt is lifted into an on-board heated mixing drum where additives are injected to reconstitute and rejuvenated the existing asphalt.

5. An on-board heated mixing plant uniformly blends the rejuvenating agent with the old asphalt.

6. The rejuvenated asphalt is delivered by conveyor belt to the on-board paving screed where it is immediately placed to the correct slope and grade.

7. While still hot, the newly recycled asphalt pavement is rolled to final its compaction.

8. **Open to Traffic**

Benefits of Hot in Place Asphalt Recycling

- Hot in-place recycling effectively addresses the classic symptoms of deteriorated oxidized pavement by rehabilitating on average the top 2 inches of surface mat.
- The stone and aggregate of the existing asphalt is preserved maintaining the structural integrity of the mix design
- All defects of the surface mat are corrected leaving a seamless mat upon completion
- No FOD generated
- Non-destructive rehabilitation of asphalt surface with no negative impact to underlying layers.
- Substantial cost savings over more traditional techniques such as milling and filling can be realized.
- Environmentally friendly

Benefits of Hot in Place Asphalt Recycling (cont)

- Significantly less interruption and impact to neighborhood, and existing infrastructure.
- Time to completed finished product is reduced
- Existing manholes, valve boxes, and other in road structures are not impacted.
- Density is maintained
- Anti rutting is improved
- Cracks are interrupted and filled.
- Aggregate stripped of the bitumen is remixed and recoated.
- Ruts and holes are filled, shoves and bumps are leveled, drainage and crowns are re-established.

Benefits of Hot in Place Asphalt Recycling (cont)

- Can be used on any HMA surface
- ADT's not an issue
- Minimal traffic impact – no road closure
- Can be used on rural or urban cross sections
- Flexibility is restored by chemically rejuvenating the aged and brittle pavement.
- Aggregate gradation and asphalt content may be modified by some variations of this process.
- Highway safety is enhanced through improved skid resistance and smoother ride.

Pre-requisites for HIR using the Heater-Scarification or Re-Heat Methods:

- Pavement must be structurally-sound. Base failures fixed prior to process.
- Pavement must have at least 3” of HMA for the Heater-Scarifier method and a depth at least 1.5 inches greater then the prescribed depth for the Re-HEAT process.

What Types of Asphalt Pavement Conditions **Are** Candidates for Hot-in-Place?

Rule of Thumb For HIR Roads

- Structural Sound with a minimum of 3” of asphalt
- Ruts under 4”
- Surface Cracking
- Block Cracking
- Alligatoring – not associated with base failure
- Raveling
- Pot holes
- Thermal Cracking
- Fatigue Cracking
- Poor Rideability
- Low coefficient of surface friction
- Surface cohesion and flexibility issues

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Thermal Cracking

Patches

Fatigue Cracking

Poor Rideability

Raveling

Rule of Thumb For

Not

Doing HIR On Roads

- Ruts greater then 4”
- Base layer cracking with Rubber Crack Filler over more then 35% of road surface
- Structural / Base issues for more then 35% of road surface
- Asphalt thickness less then 3”
- HMA Base with generally more then 2 layers of Chip Seal or similar surface treatment.
- Roads comprised of multiple layers of Chip Seal or similar construction methods
- Cul de Sacs with a radius under 45’
- Parking Lots

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Go Green, Save Green!

- Saves time & reduces "user delays" and impacts to existing infrastructure
- Minimizes the demand on oil & aggregate (non-renewable resources)
- Re-uses/recycles the existing materials – liquid asphalt & aggregates
- Eliminates milling dust & hassles
- Eliminates trucking pollution & traffic
- Reduces overall emissions by 65%
- Uses propane – a cleaner energy source
- Reduces carbon footprint by 80%
- Uses a dual stage incineration system to protect air quality during operation

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Conestoga-Rovers Carbon Footprint Analysis

Versus Conventional asphalt paving with 20% RAP Hotmix:

*** Heater Scarification emits 28% less Green House Gases**

*** Re-HEAT emits 62% less Green House Gases.**

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CTL Rejuvenator Study

- Samples where taken from an HIR project to represent existing material after the heating process and material after the rejuvenation process

- Results:
  - Air voids improved from 10.1% to 4.9% (3–5% is acceptable).
  - Viscosity & penetration improved over 21%.
  - Total bitumen content increased from 4.8% to 5.9% after addition of rejuvenating agent.
  - Stability & flow of the compacted material after treatment was statistically the same as prior to treatment.
  - Tensile Strength Ratio (TSR) of the material improved nearly 8% and increased the stripping resistance of the pavement from a typically failing test to a passing one.
  - Hamburg Wheel Analysis of the rejuvenated sample resulted in a 3.56 mm average rut depth (a very rut resistant pavement).