

Hot In-Place Recycling

Hot In-Place Recycling Short Course August 30, 2018 Valley City, North Dakota

**Ron Wilson
Donn Johnson
Dustrol, Inc.**

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Grew up in Enterprise, Kansas, graduated from Chapman High School in 1981, attended North Central Kansas Vo-Tech Beloit, Kansas for Heavy Equipment Operation, went to work for Dustrol in the spring of 1982. After that first summer working attended Kansas State for 2 years in Engineering and finally figured out I wasn't very studious and started at Dustrol full time in 1984. I am currently Vice President. My wife Ronda and I live in Towanda, Kansas and have 3 children, Ryan and his wife Taci live near Abilene, Kansas on the family farm and Ryan works for PCI roads, Riley is a lineman for PAR Electric in Wichita, Kansas, and Reagan attends WSU working towards a medical degree.

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Founded in El Dorado, KS by Ted & Barbara Dankert in 1973, we started selling emulsions for sealing asphalts and controlling dust. Two years later, we began using rented equipment to recycle asphalt to provide complementary services for asphalt pavement maintenance operations.

In 1979, we purchased our first cold milling machine and started focusing exclusively on asphalt recycling and resurfacing.

Since then, we've grown organically and through acquisition into a leading independent provider of asphalt recycling and related highway maintenance services. By 1980, our services reach stretched to include Texas, Oklahoma and Missouri.

In 1985, our first satellite office was opened in Roanoke, Texas (near Fort Worth) to support the growing operational effort in that region. We expanded our sales territory during the early 90s by opening a facility in Colorado Springs and acquired two competitors to provide immediate footprints in New Mexico and Nebraska. Recently, we've focused on building our presence in surrounding states.

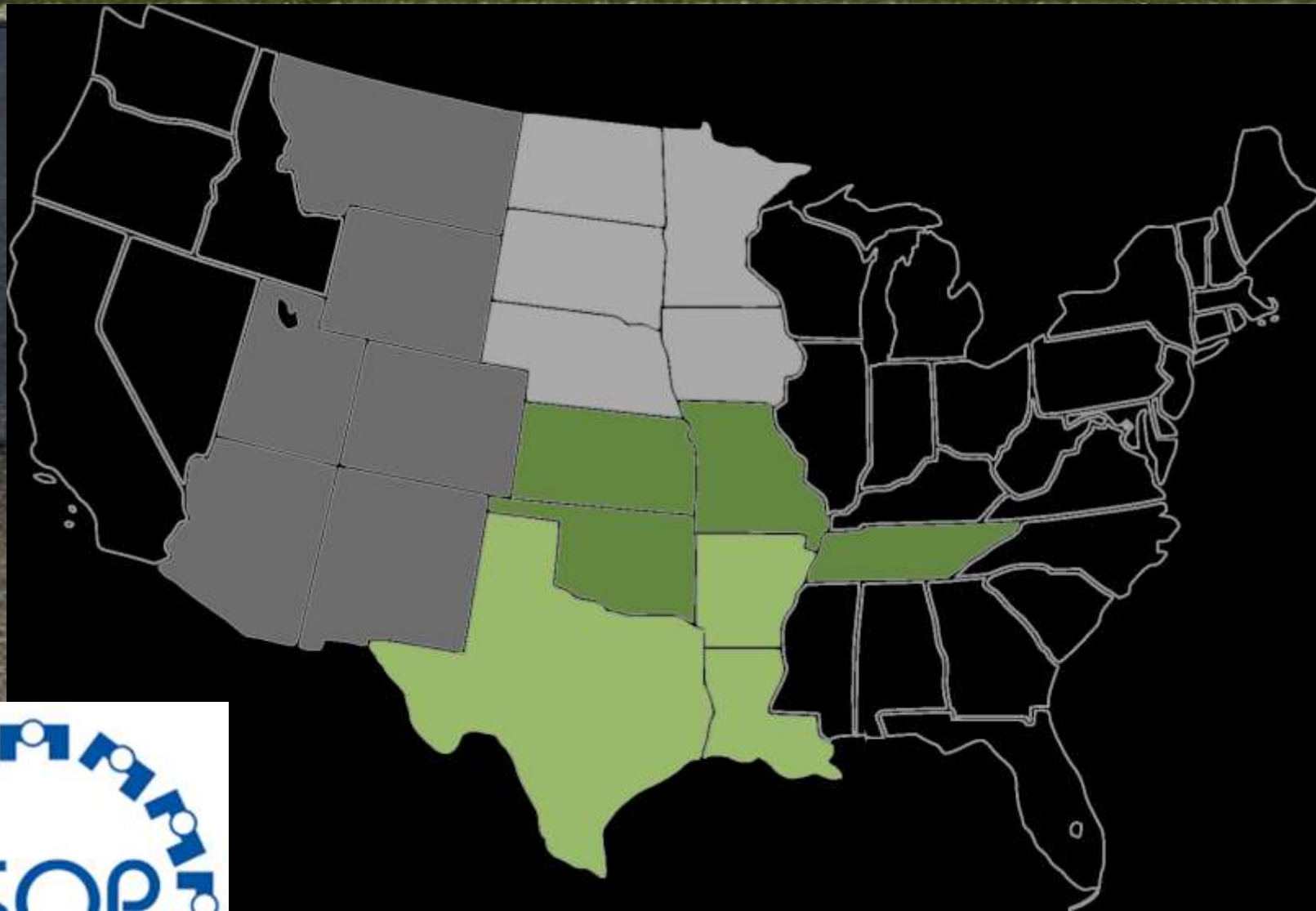
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Milling



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Rumble Strips



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Hot In-Place Recycle



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Recycling Equipment manufactured in Towanda, Kansas



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Introduction to Asphalt Recycling

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



The Bottom Line Question

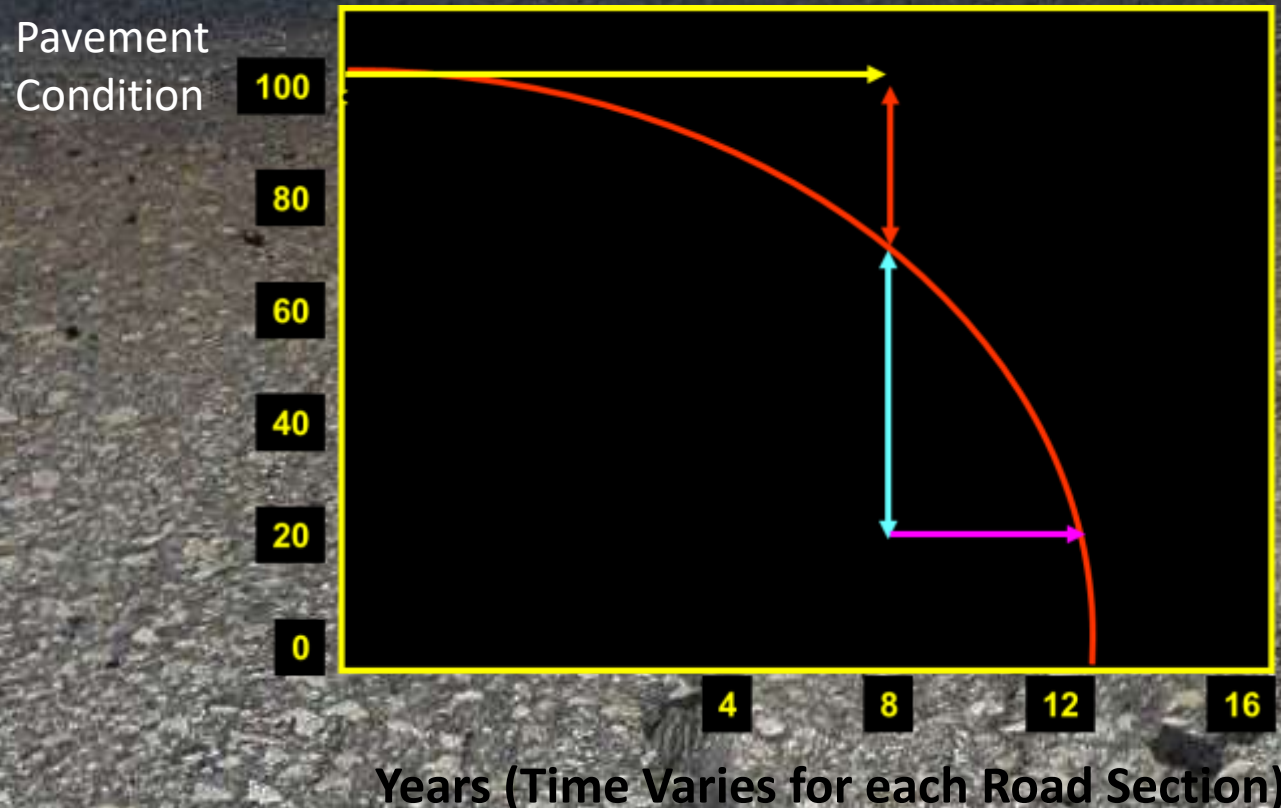
How can I maximize the return on my investment in asphalt pavement rehabilitation funding?

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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What is HIR?

Heating, reworking and rejuvenating the top 1-3 inches of an existing asphalt pavement in preparation for either a seal coat, micro-surfacing, nova chip, asphalt overlay, chip seal or other surface treatment.

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1965 on Nerge Road in Chicago

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HIR Benefits

- Repairs Surface Distresses
- Extends Life
- Improves Ride Quality
- Eliminates need for a leveling course
- Environmentally friendly
- Cost Effective



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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, county roads
- Structurally sound pavements
- Distressed surfaces
- Good drainage



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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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Candidates good and bad



No Base Problems



FATIGUE CRACKING



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THERMAL CRACKING



DELAMINATION &
LONGITUDINAL
CRACKING

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OXIDATION



TRANSVERSE CRACKING

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Excess Tire Rubber



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Excessive oil or cutbacks

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Rutting



Heaving

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NASTY!

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Extremely oily patches!

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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

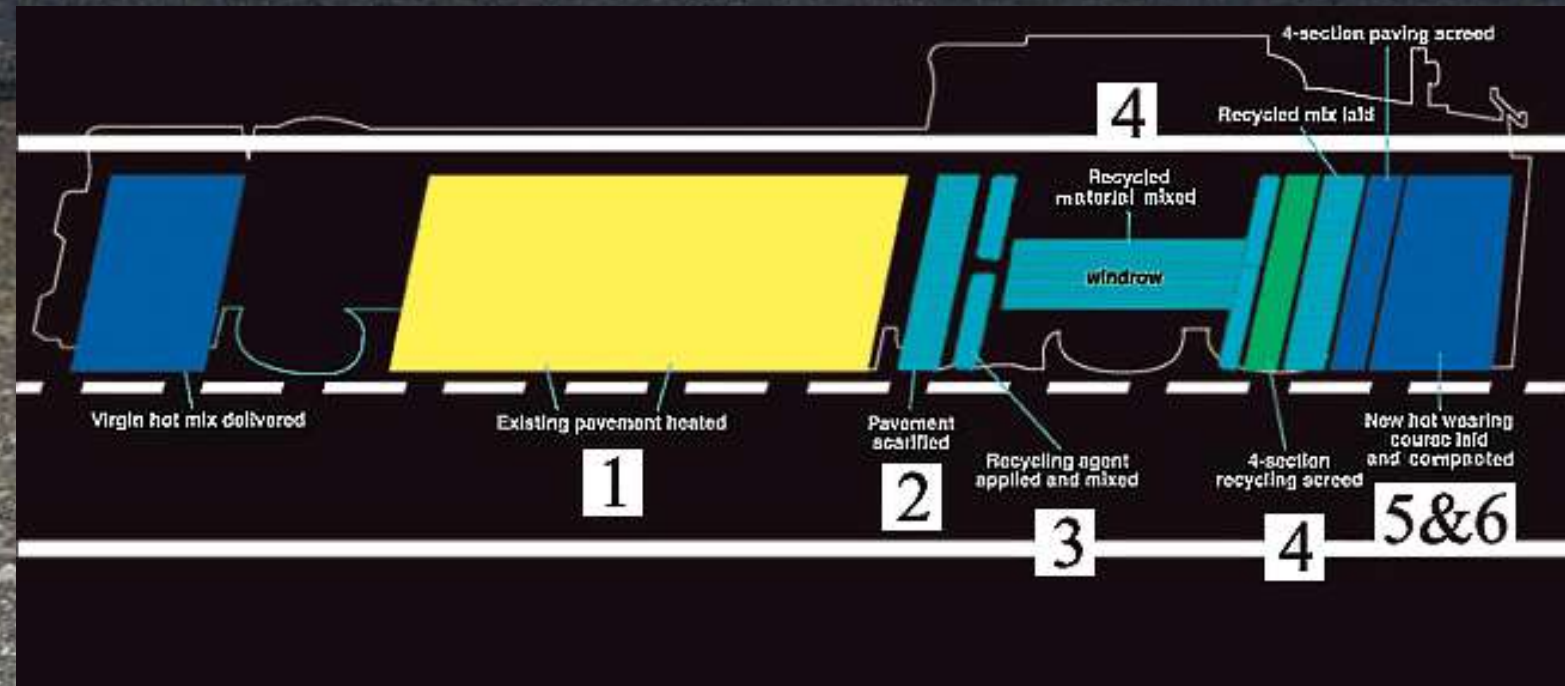


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Repaving

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



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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



Paving
Screed

Recycling Screed

Recycled Material

Virgin Hot Mix

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Repaving



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Remixing

Combining an add-
mixture of Asphalt or
Aggregate with the
Recycled Material



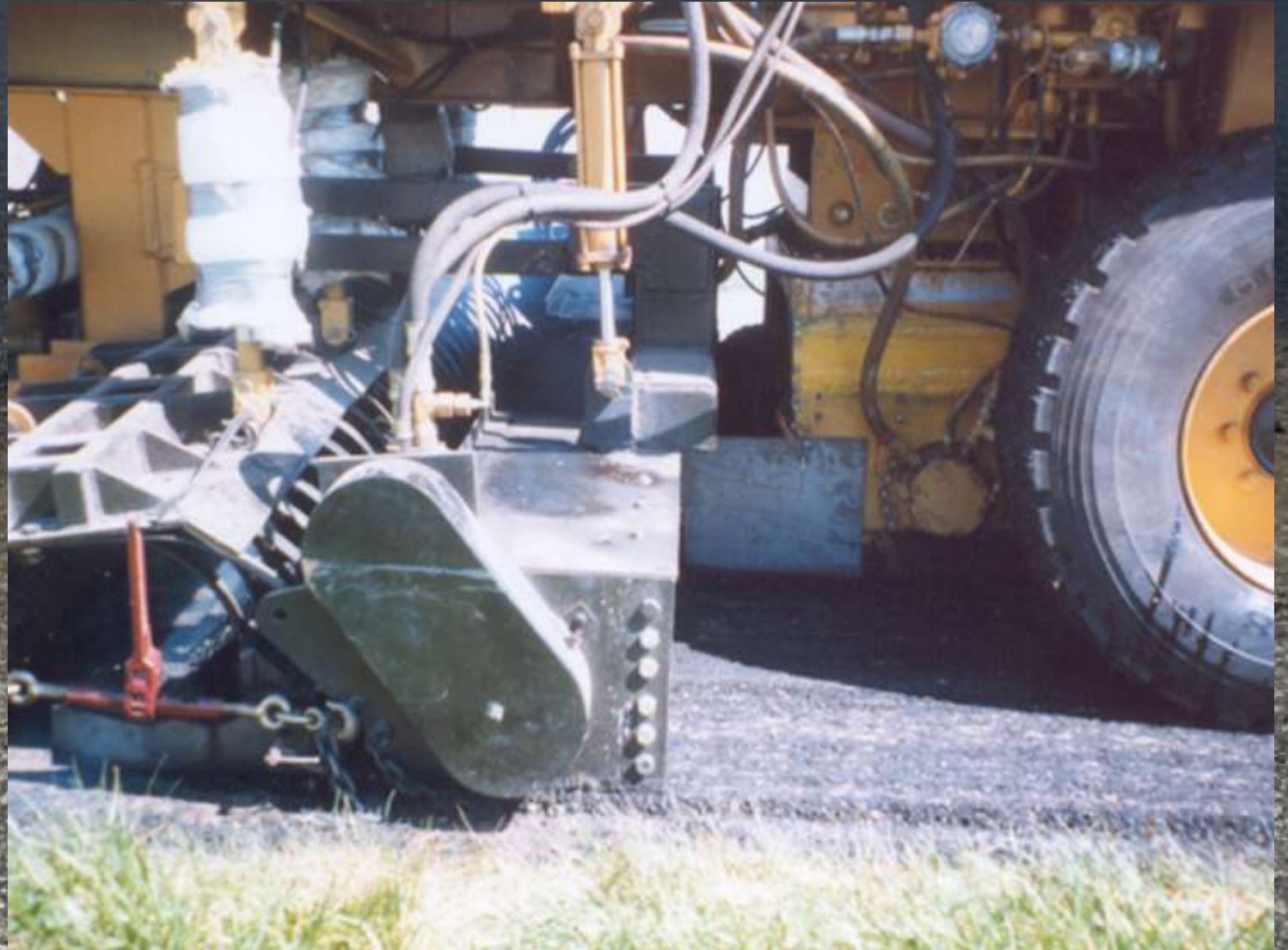
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Remixing



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Remixing



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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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KDOT K-99 TORONTO, KS.

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



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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 $\frac{1}{2}$ " 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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Paver

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



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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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Compaction

The recycled mat is then compacted



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Oscillating Compaction



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Before and After



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Material Sampling.

- Obtain material from project site
- Spread out sampling
- Cores are recommended
- Keep mix design material same as project design
- Cut cores to thickness.



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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

Testing Information Needed from Roadway Cores

TABLE 605-1: SURFACE RECYCLE MIX DESIGN REQUIREMENTS

Property	Test Method	Limits
Air Voids at 30 gyrations, (%)	KT-58, KT-15, & KT-39	Report
Tensile Strength, (psi min)	KT-56	75
Retained Strength based on cured stability, (% min)	KT-56	80
Rut Resistance, (mm max)	AASHTO TP-63	8
Thermal Cracking, (oC max)	KT-60	22

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 3"
of Existing Surface

Final Surfacing Dictated by Traffic & Road Conditions



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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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ARA-1P/ARA-2P 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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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.



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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Construction Requirements

MINIMUM HIR TEMPERATURE

Ambient Air Temperature:	HMA Surface	50 (F)
	Asphalt Seal	55 (F)

Road Surf. Temperature:	HMA Surface	55 (F)
	Asphalt Seal	60 (F)

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AADT Options

High Volume and High Truck Traffic Roadways

Interstates and US Routes:

- 2" HIR w/ HMA OL

- 2" HIR w/ Ultra-thin Bonded Asphalt Surface

Medium Volume with Moderate Truck Traffic Roadways

US and State Routes:

- 2" HIR w/ Ultra-thin Bonded Asphalt Surface

- 2" HIR w/ Microsurfacing

- 2" HIR w/ Polymerized Chip Seal

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AADT Options

Lower Volume and Minor Truck Traffic Roadways

US, State Routes, and Major County Roads:

2" HIR w/ Microsurfacing

2" HIR w/ Polymerized Chip Seal

Low Volume and Low Truck Traffic Routes

State Routes, County Roads:

2" HIR w/ Polymerized Chip Seal

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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

- 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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MODOT I-35 BETHANY, MO.

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MODOT I-35 BETHANY, MO.

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MODOT US-54 KINGDOM CITY, MO.

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MODOT US-54 KINGDOM CITY, MO.

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TXDOT
US-287
AMARILLO



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TXDOT US-287 AMARILLO

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TNDOT HIGHWAY 22 LEXINGTON, TN.

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TNDOT HIGHWAY 22 LEXINGTON, TN.

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KDOT US-50 HUTCHINSON, KS.

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KDOT US-50 HUTCHINSON, KS.

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DUELL CO. NEBRASKA

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DUELL CO. NEBRASKA

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WYDOT US-16 BUFFALO, WY.

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WYDOT US-16 BUFFALO, WY.

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CDOT HIGHWAY 133 REDSTONE, CO.

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CDOT HIGHWAY 133 REDSTONE, CO.

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SUMMARY

- Gentle phased heating and removal does not degrade aggregates and existing AC
- Retards cracks, restores flexibility, and levels the road
- Quick-high production
- Minimal traffic delays
- Allows surfacing contractor to pave with his own forces and at his own production rate consequently reducing overall costs
- Cost effective
- Environmentally friendly

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Summary of the Summary!

Hot In-Place Recycling

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



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PANE

MOBILE
ASPHALT
RECYCLE
SYSTEM II



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ARRATM

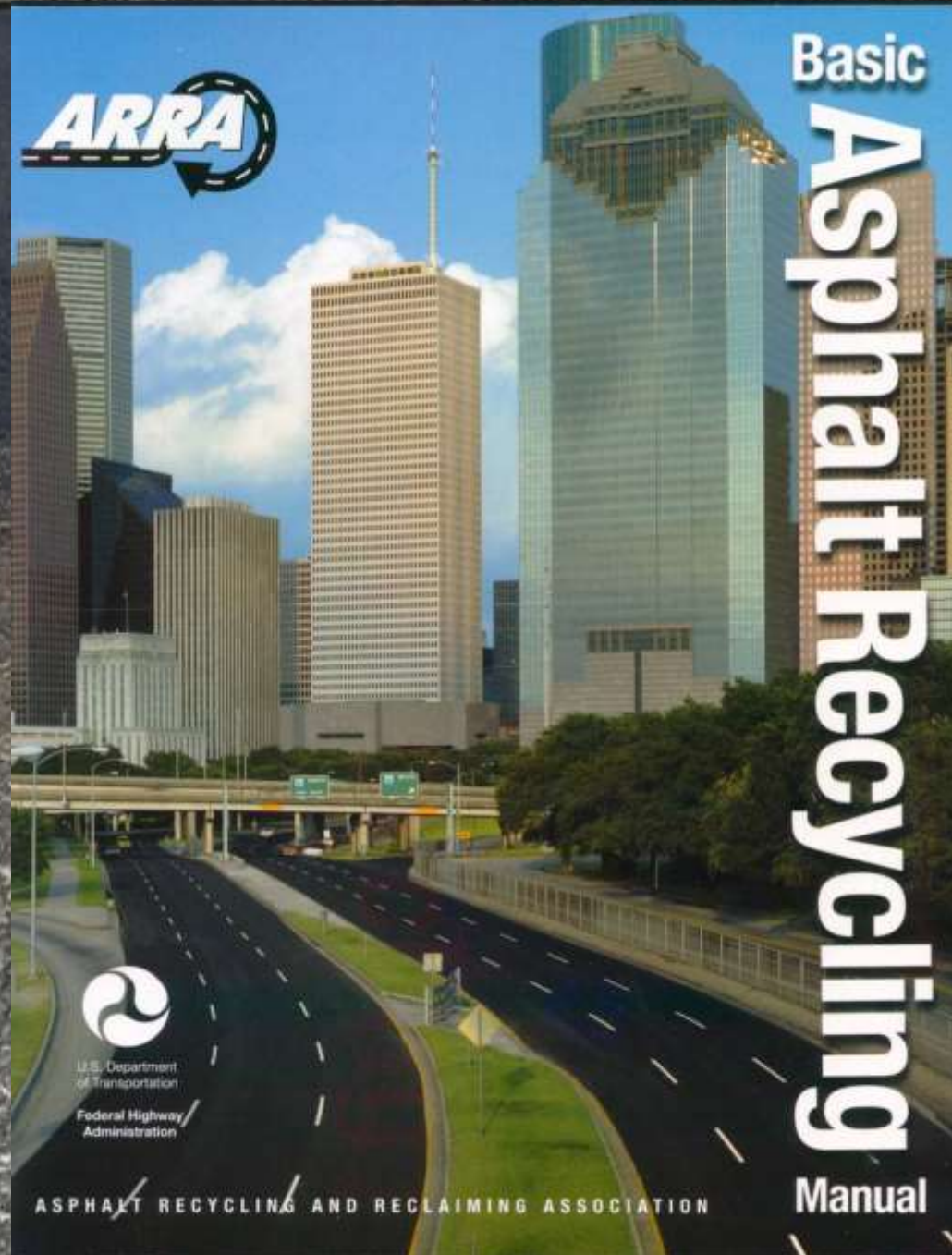
Asphalt Recycling & Reclaiming Association

<https://roadresource.org/>

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BARM



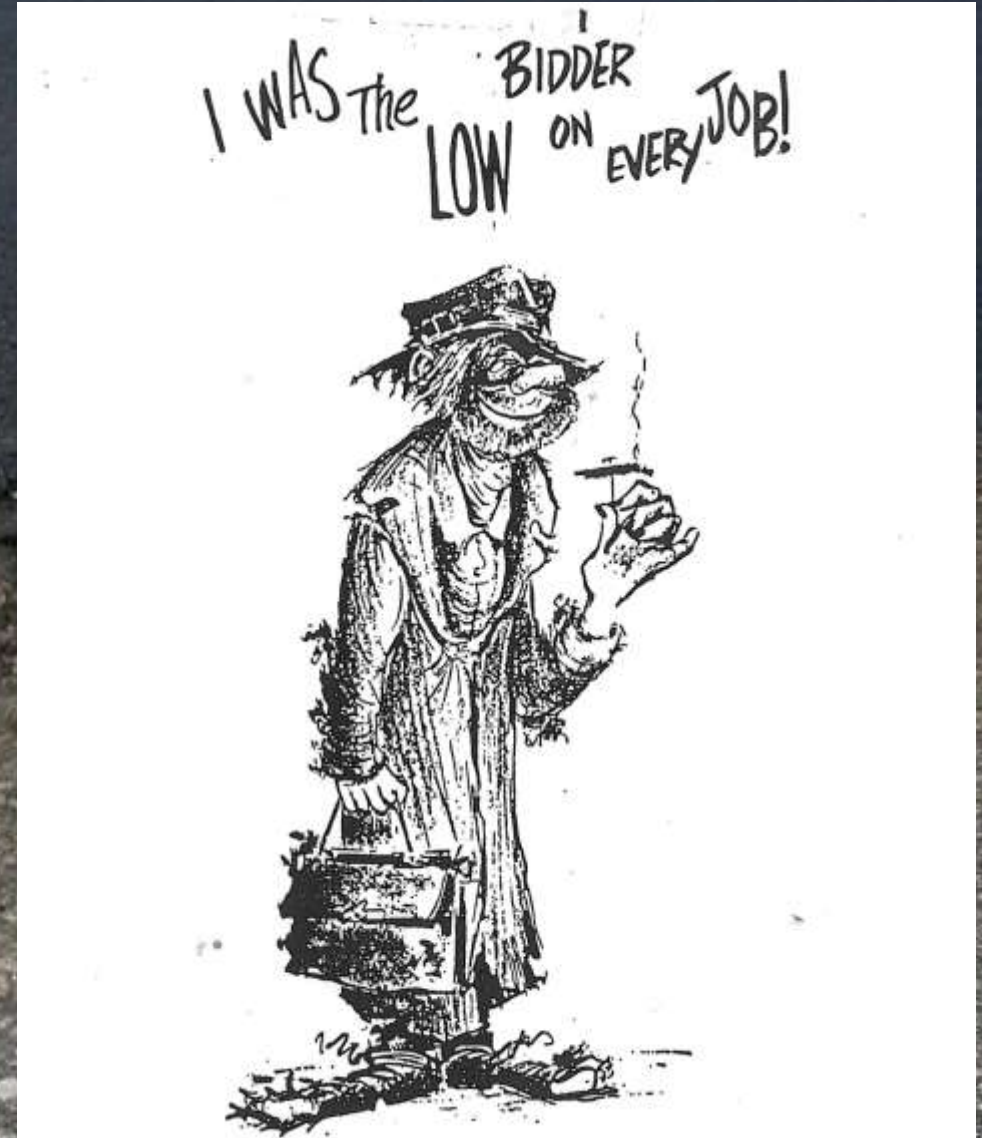
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Questions?

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