

AGENCY EXPERIENCES WITH HIR

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HIR TRAIN



Kansas History

- Kansas did its first 1" HIR project in 1977.
- Placed mostly overlays over 1" HIR
- In mid-80's started to use a lot.
- Started 2" HIR technique in 2005.
- Placed mostly chip seals over 2" HIR.
- Also used Micro, HMA O-lays & Novachip.
- Test cases with no covering surface on Low Volume roads (less than 1200 vpd)



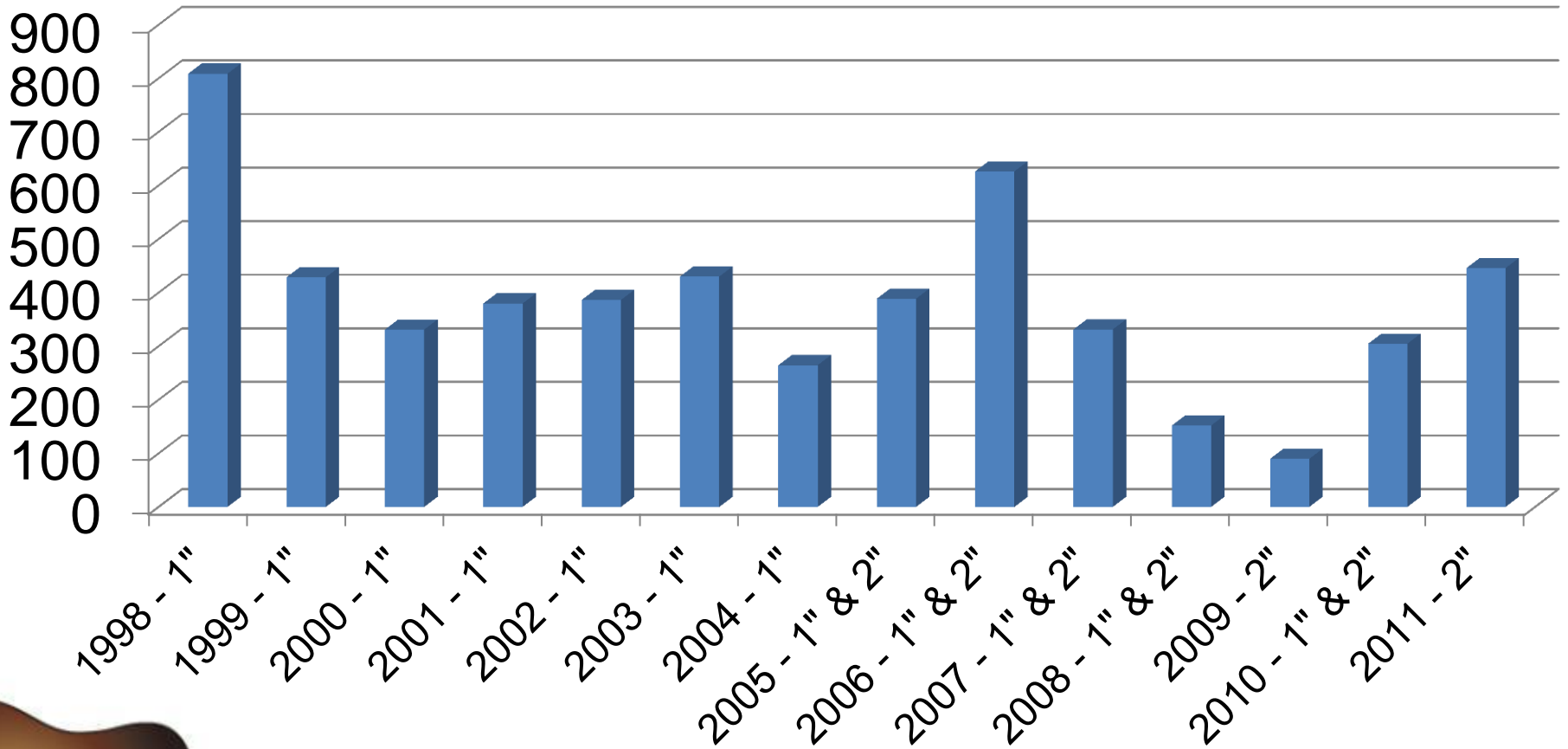
Some Other States History

- Missouri: I-29, 35, 435, US-63.
- Nebraska: US-20, 385 State Hwy's 2, 4, 20, 26, 27, 88, 92.
- Colorado: I-25, US-40 & 50, State Hwy 34.
- Oklahoma: I-40, 44, US-183, 270, 281, 283.
- New Mexico: US-550, State Hwy 36.
- Texas: I-20, US-87.



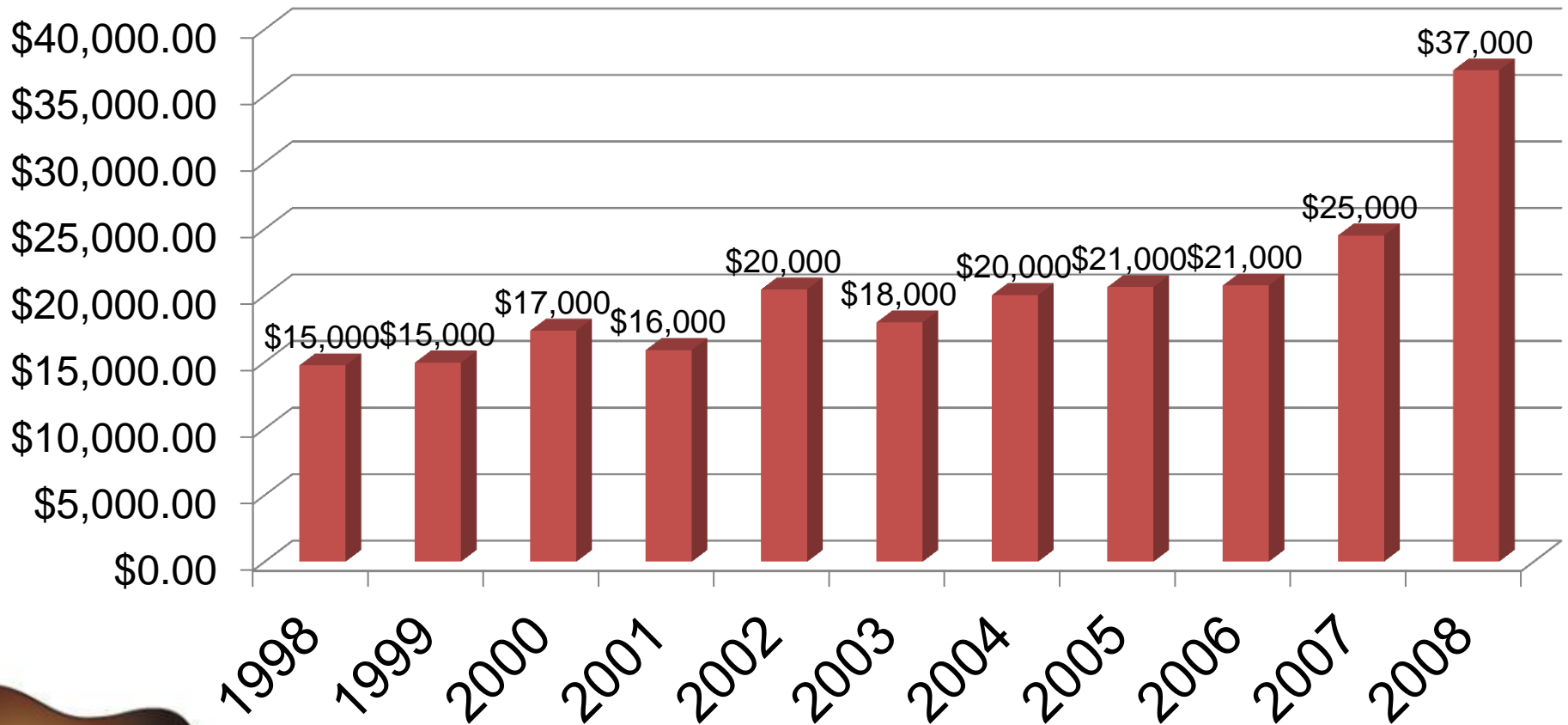
Kansas Historical Mileage

1" & 2" Hot in Place Recycle Project Miles Per Year



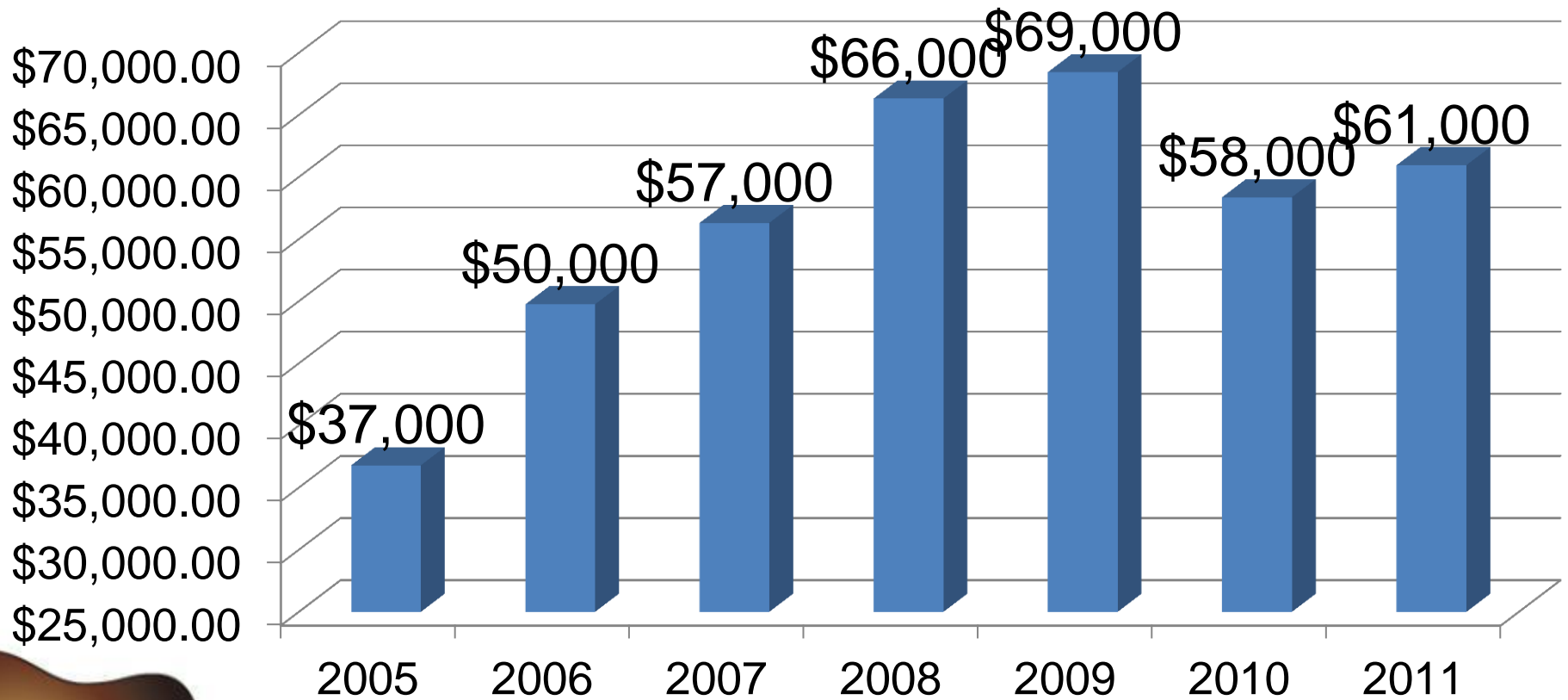
Historical Prices

1" Hot in Place Recycle Projects Average Cost Per Mile Per Year



Historical Prices

2" Hot in Place Recycle Projects Average Cost Per Mile Per Year



HIR Equipment

Pre-Heating Unit.

Self-propelled heating unit

Adjustable in width

Ports for fuel and forced air injection

Closed or shielded hood

Heats pavement to temperature that allows milling or scarifying to the specified depths

Equip each unit with a water spray system used to wet the adjacent vegetation.



Pre-heating Unit



HIR Equipment

Heating Milling Unit.

Use a self-propelled unit capable of milling, heating and windrowing the pavement

Equip this unit with automatic grade controls to mill the desired depth



Heating Milling Unit



HIR Equipment

Tunnel Heater.

Self-propelled unit capable of heating the underlying pavement while shielding the previously milled material from direct flame

Tunnel heater may be equipped with a milling unit



Tunnel heater



HIR Equipment

Distributor Unit.

Single unit that uniformly distributes the rejuvenator at the stipulated rate onto the scarified or milled material and mixes them together using a minimum of 2 telescopic milling heads



Distributor Unit



Pickup of material for laydown



HIR Equipment

Paving Unit.

Equipment shall screed and finish the milled material similar to an asphalt paver.

Self propelled independent paver complying with the asphalt paver specification may be used after the mixing operation.



Laydown



Surface behind Paver



Rolling



HIR Finished Surface



HIR Finished Project



Specification Information

605.1 DESCRIPTION

Construct the hot-in-place recycling of the existing asphalt surface

Heating the existing pavement

Hot milling the existing surface

Adding a rejuvenating agent, mixing, spreading, leveling and compacting the recycled material

BID ITEMS UNITS:

Surface Recycling (*) per Station

Asphalt Rejuvenating Agent per Ton

*Thickness



Materials Information

Asphalt Rejuvenating Agent (ARA). Provide ARA that complies with DIVISION 1200.

Contractor Mix Design. When the specified thickness of the HIR is greater than or equal to 2 inches, submit a mix design complying with TABLE 605-1.

Analyze the mixture at a minimum of 3 different ARA contents starting with 0.5%

Run the indirect tensile strength test at the lowest ARA content.

Run the Asphalt Pavement Analyzer at highest ARA content.



Testing Information

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



Testing Information

Testing procedures:

Core the pavement to obtain Reclaimed Asphalt Pavement (RAP) for the mix design.

Break down the RAP (representing the depth of the HIR) to a maximum particle size of 1 inch.

The compaction temperature range is 200°F to 250°F.

Perform all tests on plugs that are compacted to 30 gyrations, thus the air void criteria is waived.



Construction Requirements

Pavement Preparation.

Before commencing surface recycling, remove all material from the surface of the pavement which would be detrimental to the HIR or would not comply with the design criteria.



Construction Requirements

Heating and Scarifying Operations.

Use series heaters, milling units to uniformly heat and recycle the pavement to the specified depth

Flames on pavement can be prevented by heating the roadway slowly using additional heaters

Intermittent flaming of roadway or windrow that extinguishes on its own within 10 seconds is permissible

If in the opinion of the Engineer it is detrimental to the final product, production will cease

Production will cease when smoke is being produced continuously

Smoke caused when the heaters pass over a maintenance patch is excluded



Construction Requirements

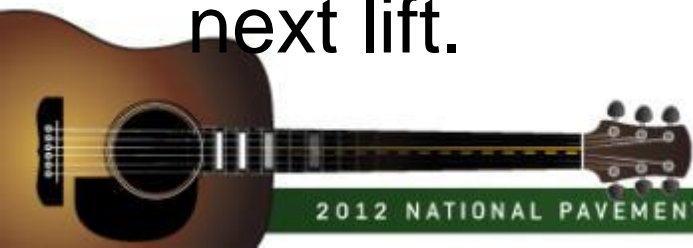
Contractor and Engineer will agree to a course of action to prevent this overheating before production is resumed

If flames or excessive smoke persist, then production is ceased until the Contractor modifies the operation

If depth of the HIR is more than 1 inch, heat the material in lifts not more than $\frac{3}{4}$ inches

When heating in multiple lifts, remove each lift at a uniform depth across the full width of the recycled pavement.

Material may be windrowed when heating the next lift.



Construction Requirements

Process Control.

(1) Depth Check.

The moving average of 3 consecutive tests shall equal or exceed the contract depth

If the 3-point moving average is less than the contract depth, a price reduction is assessed

The reduction will correspond to those segments within the 3-point moving average that were deficient in depth

If both KDOT and the Contractor agree that recycling to the contract depth would be detrimental to the project, a new unit price will be negotiated for the reduced depth



Construction Requirements

Equation 1: $P = 400 (S) (1 - (M/T))$

Where: P is Penalty. (\$0.00); S is the # of Stations (single lane) in penalty; M is the measured depth 0.000 feet; T is plan depth in feet

If 4 consecutive 3-point moving average values are less than the contract depth, stop production and evaluate the process with the Engineer

Change the process to the satisfaction of the Engineer before production is resumed

If the next 2 tests are deficient in thickness, Equation 2 will be used for the remainder of the project.

Equation 2: $P = 900 (S) (1 - (M/T))$



Construction Requirements

Temperature Requirements:

Maintain temperature of HIR, directly behind paver, between 190°F and 300°F

Temps taken within 2 feet of each other, transverse to the roadway, shall not vary by more than 30°F

If temperatures are not within the 30°F required within 1 hour after discovered, the HIR train will be stopped and the Engineer and Contractor will determine a course of action to correct the deficiency



Construction Requirements

Rejuvenating and Mixing Operations.

After heating and hot milling, uniformly add the ARA and thoroughly mix the HIR

Include all of the previously hot milled material into the mixing operation.



Construction Requirements

Use approved rolling procedure for density

Use minimum of 2 self propelled vibratory steel rollers

Use a nuclear gauge to establish rolling procedure

Achieve Max. Density before HIR is 160 (F)

Do not crush aggregate

Removing roller marks below 160 (F) is allowed in static mode



Construction Requirements

Maintain the rejuvenated pavement surface until the surface treatment is completed

When required, apply a tack coat before placing the surface treatment

If a chip seal, micro-surfacing or ultra-thin bonded asphalt surface is specified, allow the HIR surface to cure 1 week



Construction Requirements

Weather and Seasonal Limitations

Construct surface recycling when the surface is dry, and the weather is not foggy or rainy

Construct surface recycling between May 1 and September 30 and when either the minimum ambient air temperature or the road surface temperature is met



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)



Benefits

- **GREEN ASPECT:** 100% Recycle of existing surface as opposed to 2" mill & Inlay can only use 30% of RAP on this project so 70% of aggregate needs to be virgin material.
- Only uses approximately 1% new oil verses 3-5% for HMA with RAP.
- Reduces hauling of material over existing roadway.
- Does not increase the elevation of roadway as opposed to overlays and so shoulders don't need addressing.
- No drop offs with this process.



Candidates for HIR

- Transverse thermo cracks, longitudinal cracks, and fatigue cracking in wheel paths
- Ride #'s, oxidation, and surface course rutting
- Previous actions within the top 3" is important
- Is overall structure carrying the present loads



Challenges

- HMA Industry says product and voids structure not as good as their Superpave mix.
- We counter with rutting hasn't been an issue.
- Inexperience contractor can become a disaster.
- Fire issues in dry conditions can be a problem.
- Smoke issues due to incorrect heating or maintenance patches.
- Questioning from public on why sealing HMA?



Cost Consideration

2" SR w/ Chip seal = \$95-100 K/centerline mile

- Other surface courses used: Ultra-thin bonded asphalt surface (Novachip), Modified Slurry seal (microsurfacing), HMA if structure needed
- Experimenting with 1 mile section of leaving the HIR as surface last year.
- 2 projects picked let with no surface treatment: K-31 in Wabaunsee Co. (10 miles) and K-4 in Ellsworth Co. (7 miles)



Competition

- Bidding 2" HIR w/ Chip Seal versus 2" Cold Mill & 2" Inlay
- HMA Contractor needs to be allowed to retain all the RAP to be competitive.
- Asphalt Price Adjustment.
- 1% ARA oil versus 3 to 5% Asphalt Cement oil for HMA with RAP.



QUESTIONS

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