Common Sense Pothole Patching

The makers of UPM mix
Unique Paving Materials Corp.

Presented: October 2018

MICHIGAN Winter Operations Conference

Please silence your cell phones

Extending a limited budget

Maintenance and rehabilitation consume about 80% of the typical local budget.

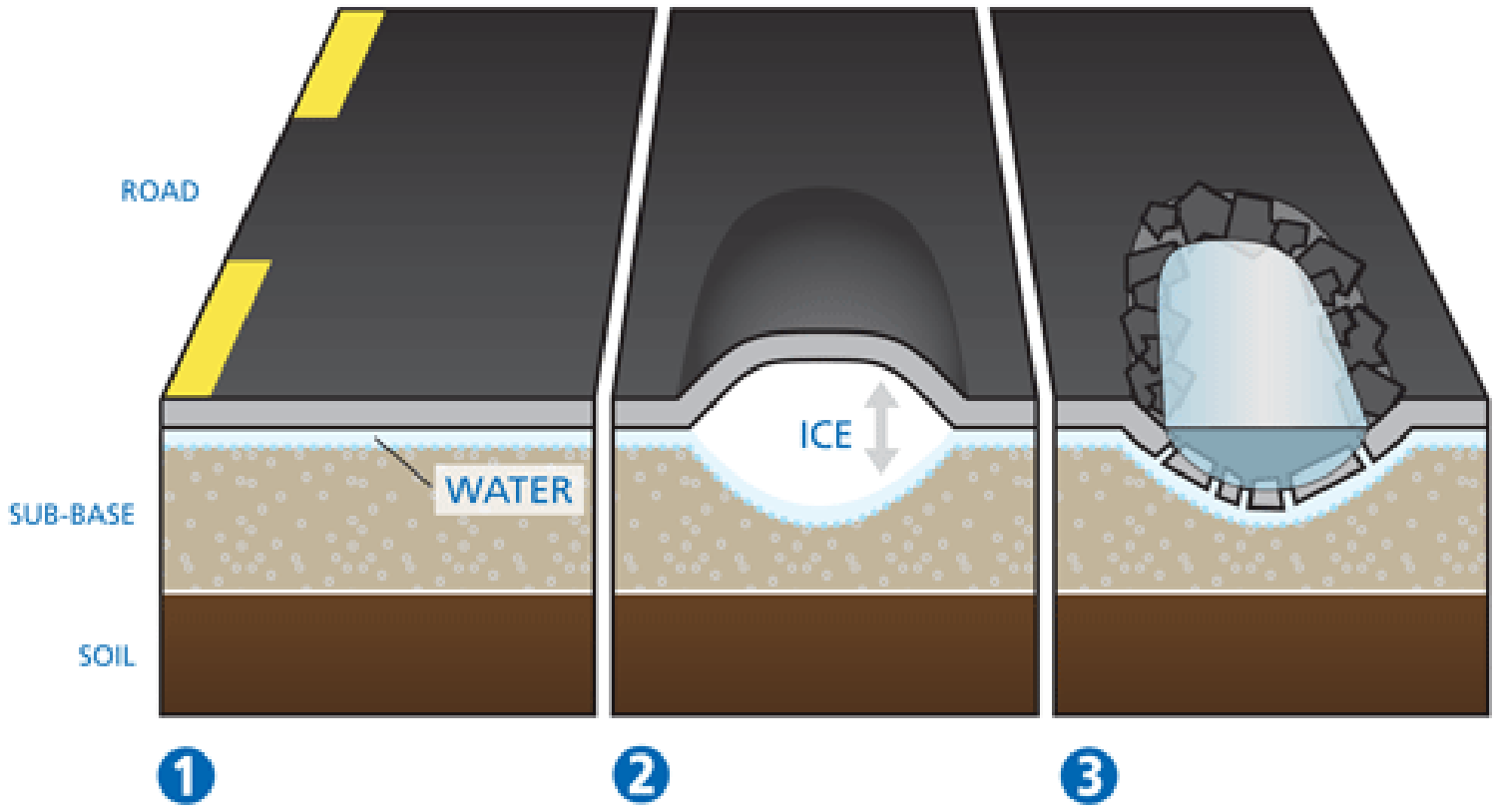
Pothole patching is likely the single most common pavement maintenance technique in the U.S. and possibly the most overlooked opportunity to improve local maintenance effectiveness.

Wilson, Thomas; Strategic Highway Research Program; SHRP-H-353

Overview

- Differences in cold mixes
- Proper patching technique/steps
- Problems you are having & solutions
- Hot boxes
- Stockpiles
- Specs

The Birth of a Pothole




FEELS LIKE
PIONEER SUSPENSION


POTHOLE REPAIR CAME TO
AN ABRUPT HAULT TODAY WHEN
THE POTHOLE REPAIR TRUCK
FELL IN A POTHOLE

Who Makes Cold Mix?

- 60% of all plants in the Midwest **DO NOT** make cold mix

Most Cold Mix

- Virtually no QC
- Same mix design year after year
- Inconsistent
- Poor performance

What Do End-Users Say about Cold Mix?

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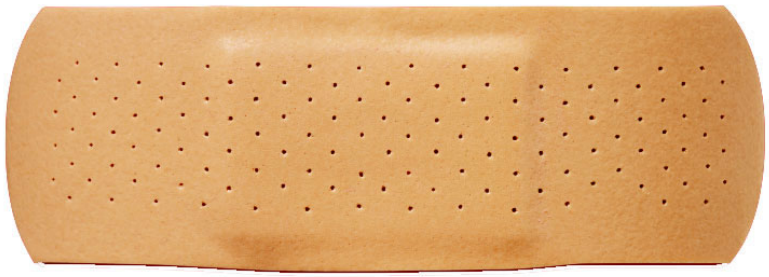
"It's Cold Mix"



"We Try Not to Use Cold Mix"

Most People Don’t Expect Much From Cold Mix

Common Complaints

- Poor workability
- Large chunks
- Will not stay in the hole

Common Complaints

The makers of UPM mix
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Does not work in water

To Make Hot Mix You Need…

- QA & QC Lab
- Plant calibrated
- Aggregate approved
- Mix designs approved
- Daily monitoring w/ documentation

Cold Mix is not Industry Controlled Like Hot Mix

Control Parameters	Super Pave	Federal HMA	State HMA	UPM® mix	Cold Mix
				Permanent Repair Material	HP Cold Mix
Aggregate Gradation	●	●	●	●	
Aggregate Morphology	●	●	●	●	
Asphalt Grade	●	●	●	●	
Stripping	●	●	●	●	
Cohesion	●	●	●	●	
Finished Product Analysis	●	●	●	●	
Performance Specifications	●	●	●	●	

Design and Testing are the only means to Consistent Quality

What Makes a Good Cold Mix?

- A mix design specific to cold mix
- An aggregate specific to cold mix
  - Cold mix does not get compacted like HMA during installation
- An asphalt blend specific to cold mix
- A QC plan to produce and store
  - Cold mix is not hot mix and needs to be handled differently.

Good Mix Starts with a Good Aggregate!

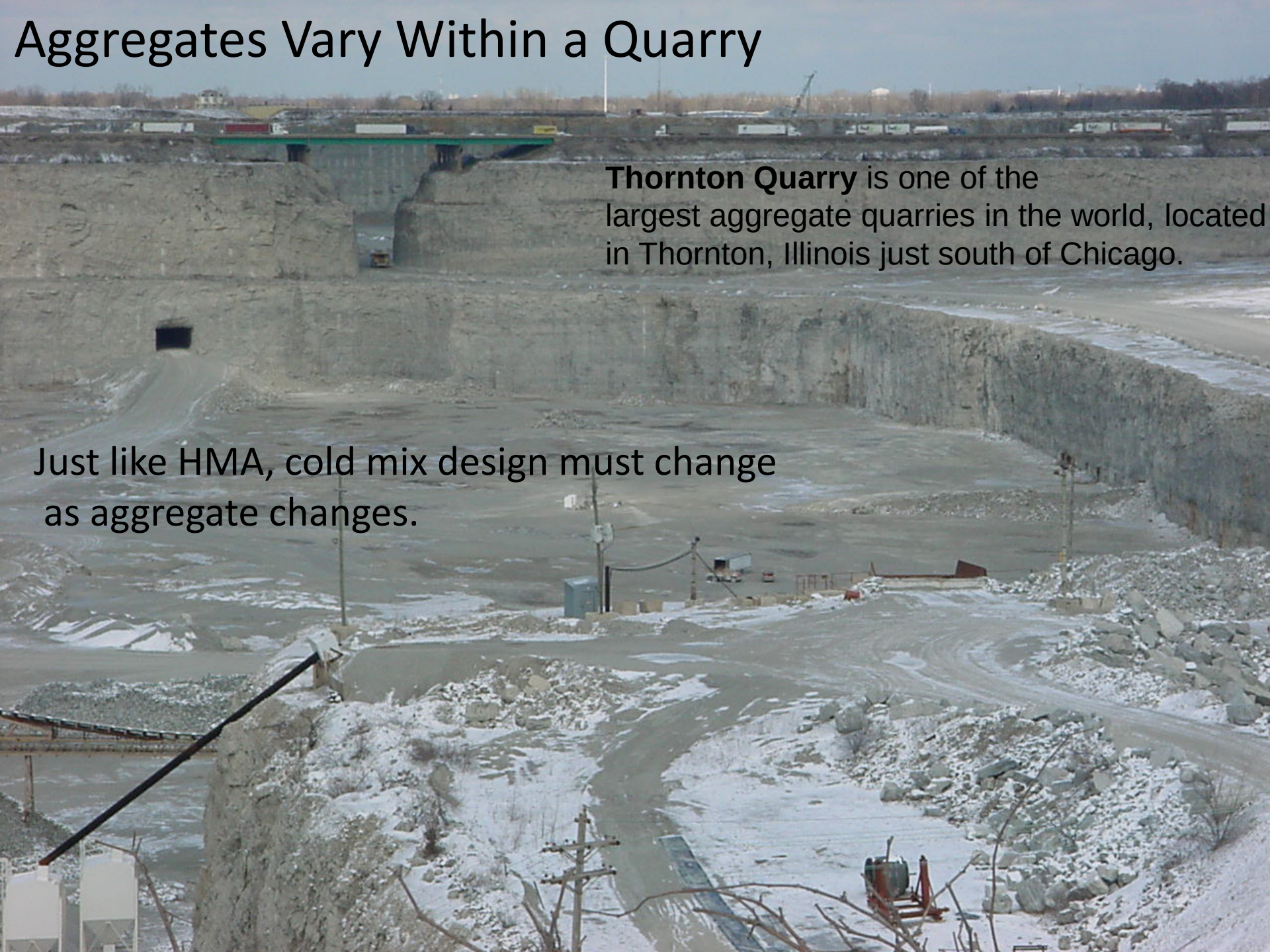
- **Tested *at <u>least</u>* once a year**
- **6 ASTM tests Run**

1. Sieve (Gradation) analysis
2. -200 sieve wash loss
3. Absorption
4. LA Abrasion (durability)
5. Sodium Soundness (freeze thaw)
6. Specific gravity

Cold Mix is Made With a Wide Varity of Aggregates

95% of your cold mix is aggregate.
Get is right, you have the opportunity to produce good cold mix.
Get it wrong, **you cannot make** a good cold mix.

Aggregates Vary Within a Quarry



Thornton Quarry is one of the largest aggregate quarries in the world, located in Thornton, Illinois just south of Chicago.

Just like HMA, cold mix design must change as aggregate changes.

Sieve Analysis

Measure aggregate size distribution.

The aggregate column in the cold mix matrix must be able to support the load.

Excessive minus 200s (dust) will decrease workability and may lead to stripping.

Absorption

The asphalt film:

- Can go on the aggregate
- In the aggregate
- In the voids

Cost and performance are affected by the quantity and location of the film in the cold mix matrix.

LA Abrasion

Measures the aggregates durability.
Will the aggregate break after repeated loading?

Strip Tests, Will the Cold Mix Work in Water

High Performance

Remember the blend is the glue that holds everything together.

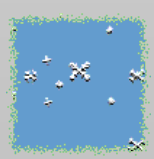
The difference between aggregate and cold mix is the asphalt film. Film performance determines cold mix performance.

If the blend does not stay on the aggregate, the patch will fail.

Should cold mix be Seasonally Graded?

For optimum performance cold mix should be seasonally graded for year round performance.

Suggested grading:

Seasonal Grade	Winter	Spring/Fall	Summer 4.0	Summer 5.0
To Be Applied When Outdoor Temperature Is:	40ºF and Below (4º C and Below)	40º to 60º F (4º to 16º C)	60º to 80º F (16º to 27º C)	80º and Above (27º and Above)
				

Cold mix must be workable for handling and to achieve adequate compaction during installation. Improperly installed cold mix reduces performance life.

Production at the Plant

- Field Tech to oversee QC
- Pre-check the aggregate
- Set asphalt content based on aggregate tests (Like HMA)
- Tests during production
- Samples collected for lab extraction

A Quality Material Should…

- have a mix design like HMA with documents
- be well coated and look good
- have a good stockpile location

Insist on Quality Control & References

Application Steps

- Common sense
- **Simple** procedures
- Attitude!

Never enough time to clean out the holes….

But always enough time to do it Again.. & Again & Again

Patching is like Painting

Some areas needs prep, some don't

Must Have Tools on the Truck

- Shovel
- Asphalt lute (Larger patches)
- Good broom (STIFFWITCH® Pothole broom)
- Leaf blower
- Bucket of dry sand / Portland cement dust
- Utility Knife with extra blades

Use a broom or a blower!

Where Does Failed Repair Materials Go?

The makers of UPM mix
Unique Paving Materials Corp.

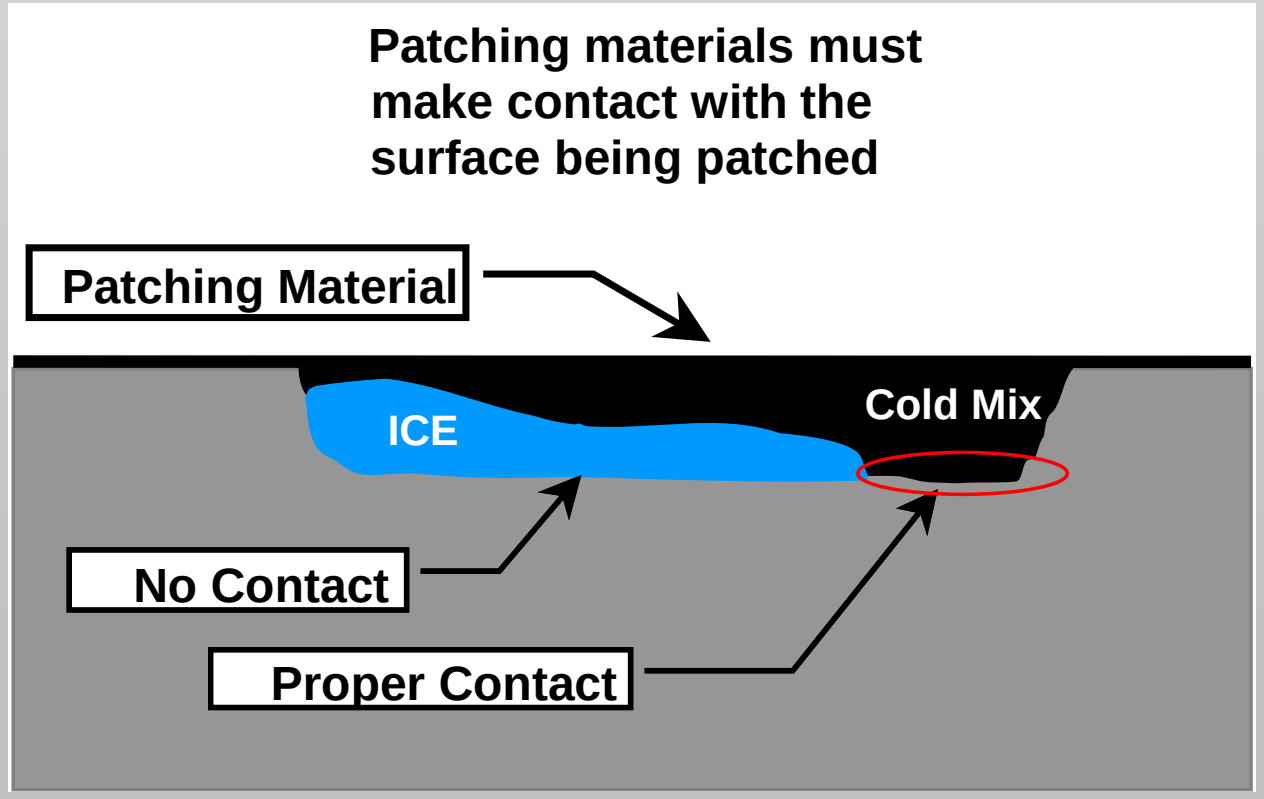
Failed HMA on the sidewalk

Failed Material Accumulates in Curbs, Tree Lawns and Drain Pipes.

Hole Preparation

Get the hole as clean as possible by removing any loose debris and dirt.

The UPM® mix sticks to the first thing it comes in contact with, preferably good pavement.



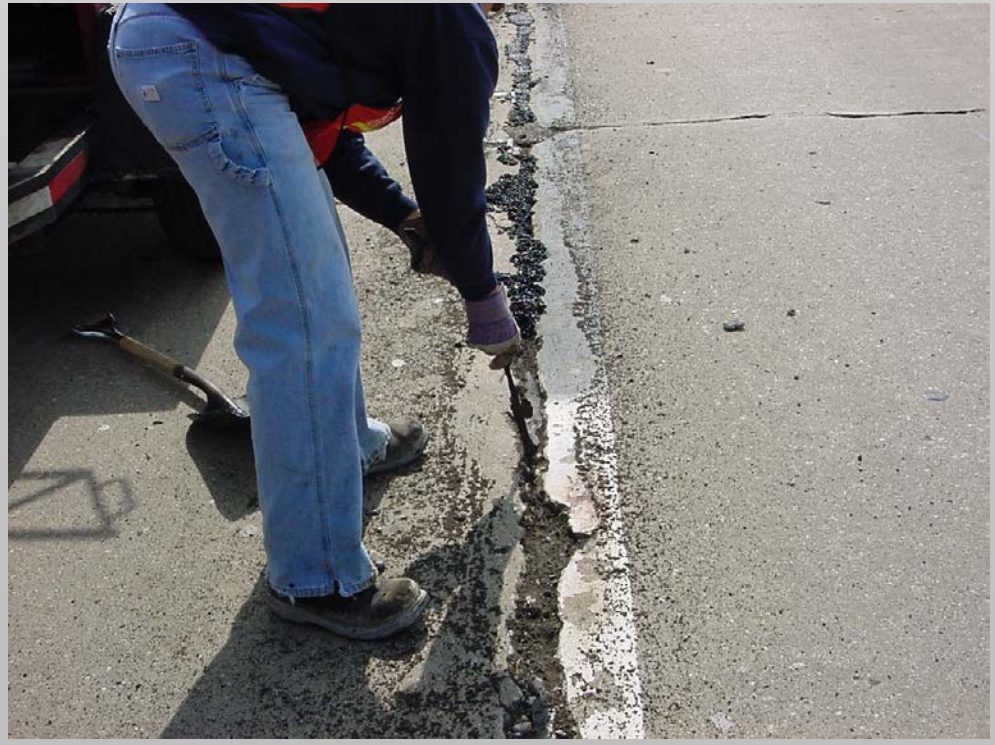
Throw & Go Application

It is fast, but not effective with any asphalt patching material, including hot mix asphalt.

Patching without preparation and compaction does not work.

Remove Large Chunks & Crack Filler

Previously failed materials are not effective as patch materials.



Remove Petro-Mat

Cut out with utility knife or burn it with a touch.

Feathered or Thin Patches

This is a difficult repair.

Loose debris must be removed.

Edges must be compacted.

<u>Making this repair will require additional time</u>.

Application Steps

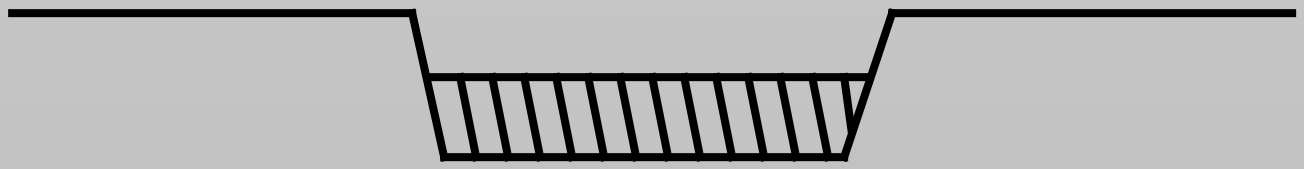
1. Sweep / blow the hole out
2. Add material. Holes deeper than 3” should be filled in lifts.
3. Final lift should be ¾” to 1” above surface
4. Compact!

   The more the better!!

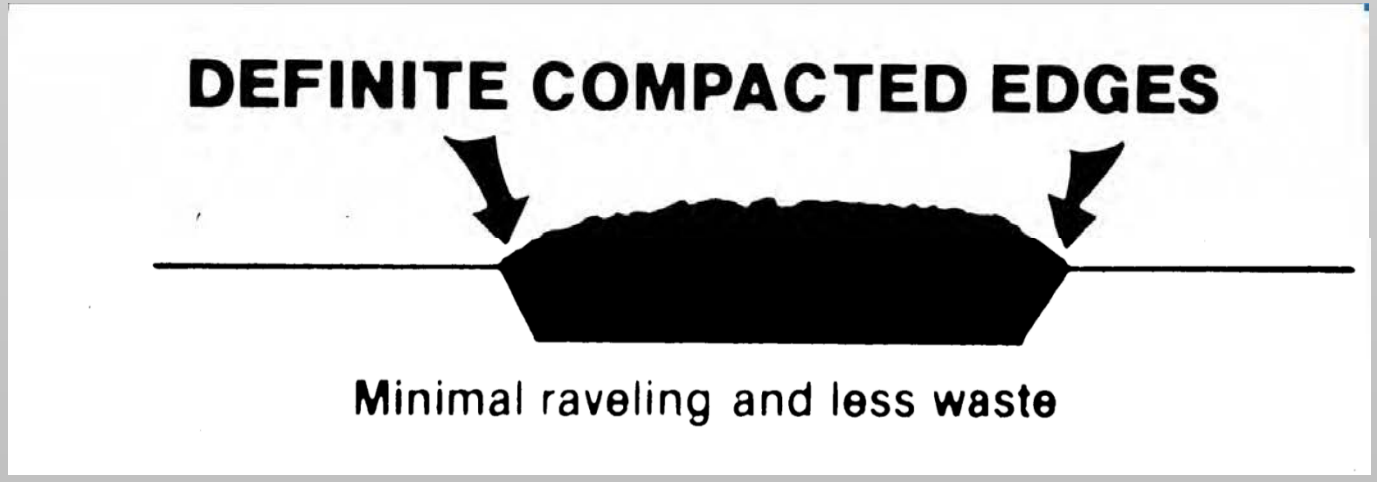
Application Steps

Add material. Holes deeper than 3” should be filled in lifts **to increase stability.**

Too much material might push.



Work Material Like Hot Mix



Compact “With a Purpose”!!


CAT
ebaumsworld.com

Drive over Patch

No “Courtesy” drive over!

Make several passes.

Back & Forth over patch.

Quality installation will extend life of repair!

Application Steps

1. Sweep / blow the hole out
2. Add material. Holes deeper than 3” should be filled in lifts.
3. Final lift should be ¾” to 1” above surface.
4. Compact!!
5. Dust patch

Dust Patch

Dust patch to tighten the surface and to minimize tracking.

Water Filled Holes Shouldn't Be a Problem

Remove loose debits. Water is not a problem for high performance cold mix.

Cold Mix Repairs on Concrete

- Cold mix remains flexible and will not blow out with expansion and contraction.
- Patching with concrete is sometimes not effective due to differences in expansion characteristics between the patching material and the area around it.

Every Repair is Unique

- Look at the repair.
- Is it in the wheel lane?
- Are multiple materials or multiple repair involved?
- Consider reason for failure
- Do the materials need to be removed prior to repair?
- Would a tack material increase repair material life?
- If different materials involved, consider using edge seal.
- Simply patching the patch material, without considering how best to create a long term solution, will force a second visit to re-patch the area again.

Trip Hazards

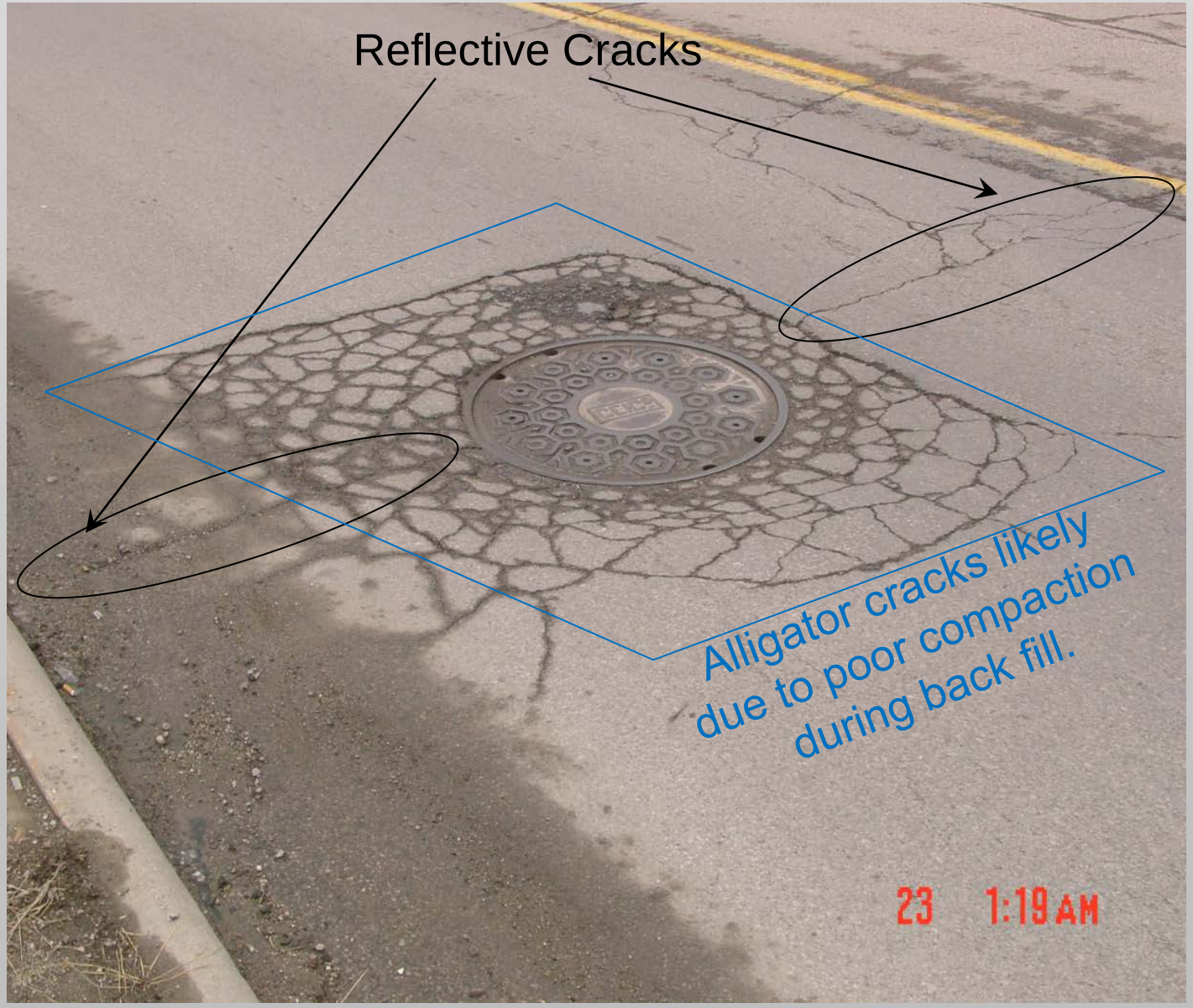
Know The Cause of Road Failure

Future Pothole

HMA will not survive over poor backfill; UPM is preferred.

Reflective cracks may be unavoidable, however, proper selection of back-fill and compaction will greatly reduce alligator cracking.

Fix the cause-eliminate the re-repair.



Manhole Repair

- 3 to 4 inch deep repair.
- Minimum equipment.
- Minimum manpower.

Manhole Repair

Manhole Repair

Manhole Repair

Manhole Repair

Manhole Repair

6 Months & Looks Great!

20 Months!

The City of Milwaukee uses high performance cold mix for long term repairs.

20 months after installation

SHRP Study

In <u>wet weather</u> (>32F) proprietary cold mix was superior to HMA in both cold and warm pothole repairs.

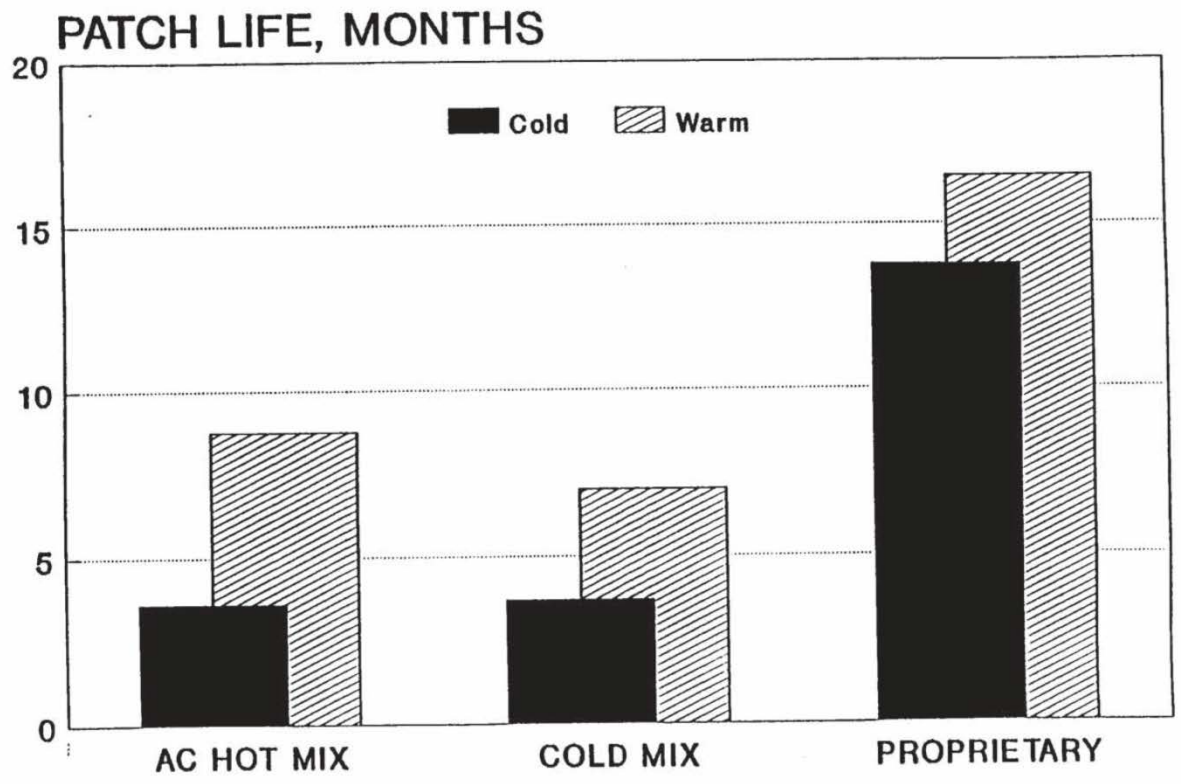


Figure 6-3. Life expectancy of patch materials placed in wet potholes in cold and warm temperatures.

SHRP Study

In <u>cold temperatures</u> (<32F) proprietary cold mix was superior to HMA in both wet and dry pothole repairs.

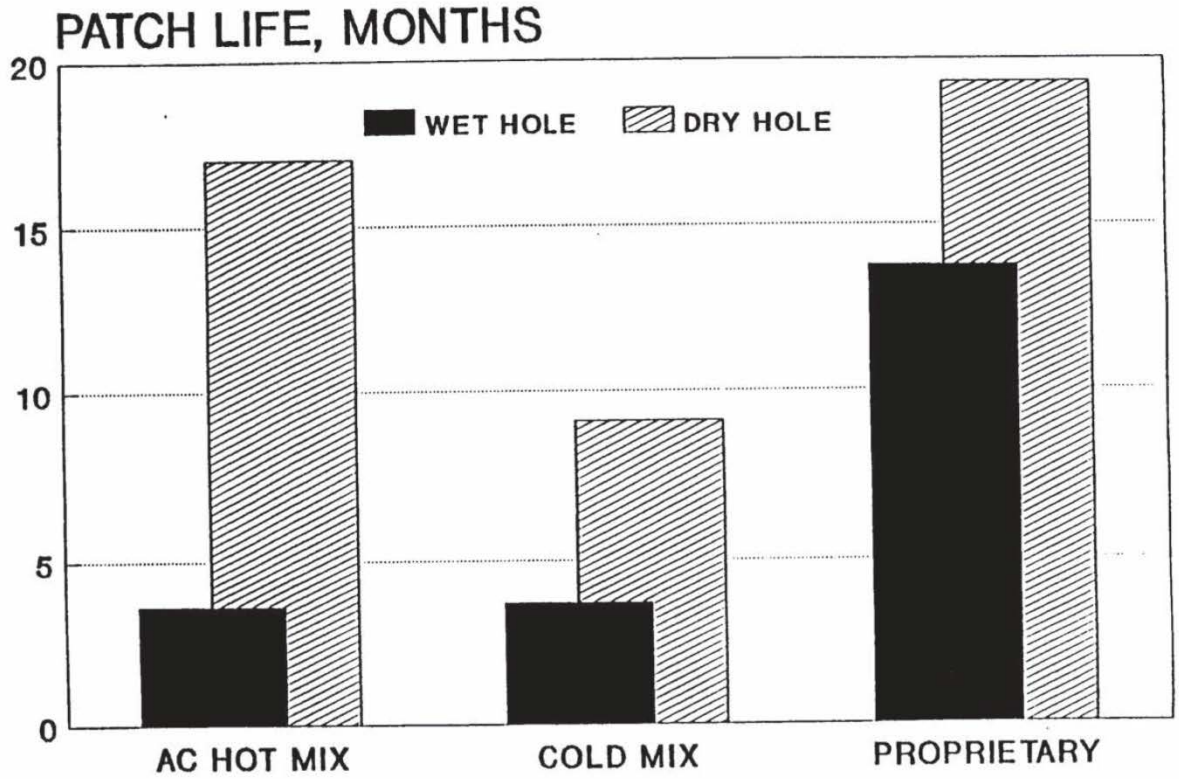


Figure 6-4. Life expectancy of patches placed in wet and dry potholes, in cold temperatures.

HMA – Weather and Temperature Limitations

Do not place HMA plant mix on any wet surface or when the surface temperature is less than specified in Table 402-2, Temperature and Seasonal Requirements, or when weather conditions will prevent proper handling or finishing of the HMA mixtures.

TABLE 402-2 TEMPERATURE AND SEASONAL REQUIREMENTS	
Nominal Compacted Lift Thickness	Surface Temperature Minimum
>=100 mm (approx. 4 inches)	5 °C (40 °F)
>= 50 mm but < 100 mm	8 °C (47 °F)
< 50 mm (approx. 2 inches)	10 °C (50 °F)

Table 402-2 was simplified for presentation.
The complete document is available at: USDOT FHWA Hot Mix Asphalt Pavement Guidelines

Hot Boxes

- 100 Degrees or so
- Too **Hot** will ruin the material
- Too **Hot** possible flash!
- Try to empty the box by shifts end

Spray Patching

- Another tool
- Emulsion won’t break below 32°F.
- Won’t work in poor weather
- Rock & emulsion need to be compatible.
- Requires experienced operator.
- Low labor cost, but equipment maintenance cost.

Stockpiles

- Keep covered if possible.
- Keep mounded up as best as possible.
- Take what you need.
- Don’t fluff the pile.
- Keep dust away.
- The smaller the pile, the shorter the shelf life.
- Work off of one end.

Common Complaints

Poor Pile Management

Bad Stockpiles

Proper Stockpiles

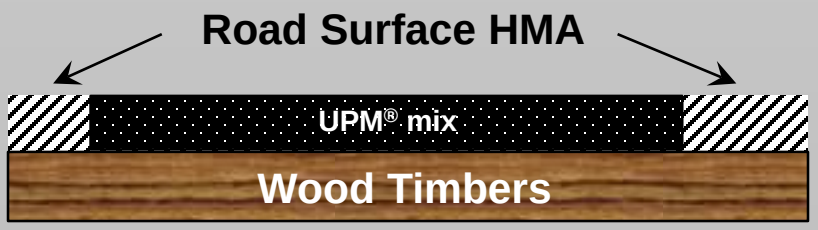
Summary

- Choose good material
- Sweep & blow out holes
- Bring up in lifts
- Edge the material
- Compact with a purpose!
- Dust patches
- Have a plan!

Bridge Repair

Daily repairs converted to no re-repairs followed mill and overlay 6 moths later.

Cold mix flexes with the supporting structure.



Properly Installed Cold Mix

Original problem, March 2013


1 month

- Rural road in Pennsylvania
- Limited budget
- Road surface below grade, water on surface, base remained wet.
- Repair remained in place for 63 months until overlay was installed.


June 25, 2018
63 months

St. Louis Repair with MODOT

Roadside hill causes water on surface, in addition to hydrostatic pressure forced water up through the surface.

Repairs every 10 days were shifted to 22 months maintenance free, until mill and overlay installed.

14 Year Cold Mix Study-City of Lexington, KY

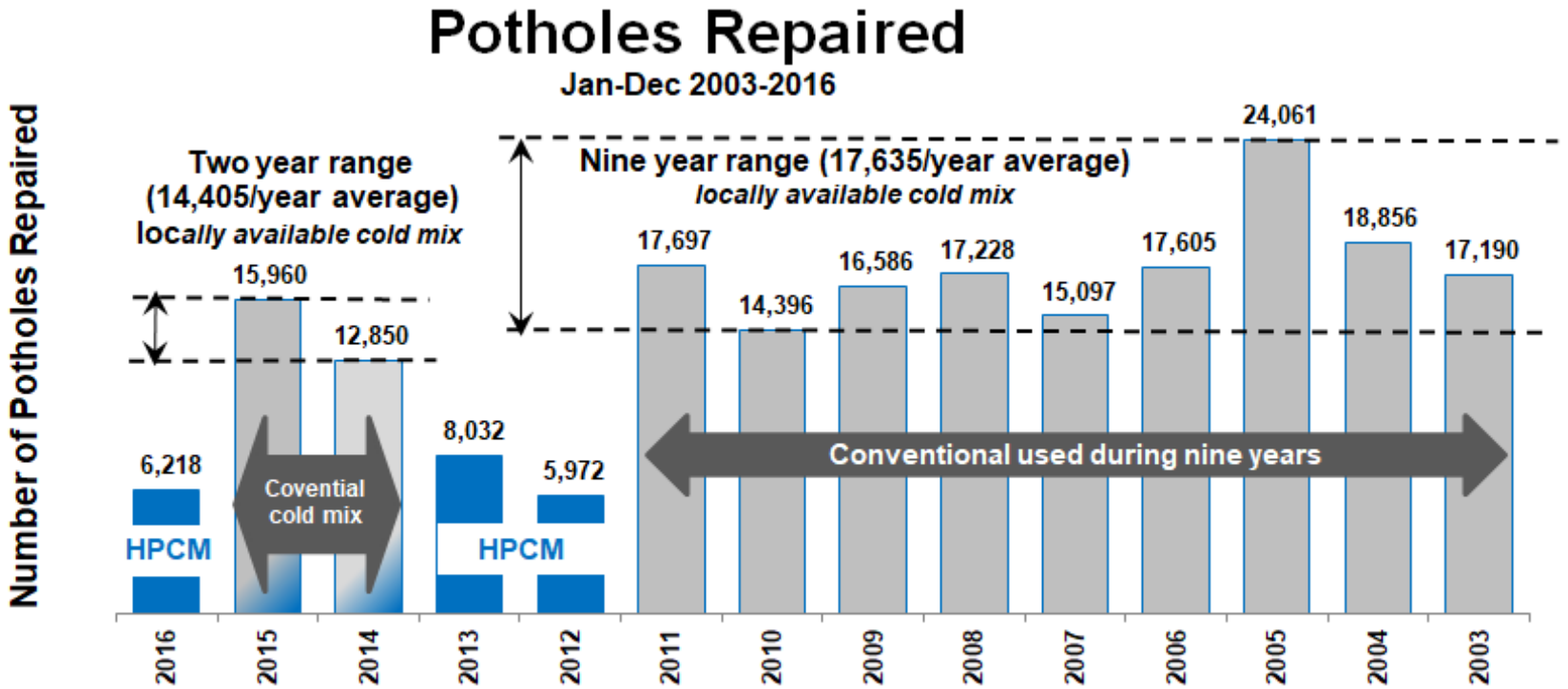
- Lexington, KY
- 14 year pothole maintenance study
- 2,124 lane miles
- 207,747 potholes
- $32.00 average cost of pothole
- 60% reduction in potholes using Permanent Pavement Repair Material
- $340,256 in annual savings

POTHOLES REPAIRED 2003-2016														
	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
January	621	796	177	492	678	2,133	718	837	748	761	1,406	2,545	561	1,306
February	598	1,315	3,481	680	724	3,670	1,955	1,979	1,841	1,710	1,001	3,614	2,980	2,156
March	1,479	4,417	2,843	1,406	1,206	5,204	1,489	3,054	2,673	2,372	1,795	4,153	2,274	2,682
April	796	1,792	1,471	1,741	558	1,628	2,023	2,232	2,191	2,384	1,999	2,401	1,887	2,092
May	146	903	1,063	1,369	587	1,683	1,249	1,390	2,077	1,657	1,614	2,171	2,208	1,834
June	822	1,011	894	620	615	735	2,236	1,152	1,192	992	1,716	2,373	1,712	1,155
July	420	742	574	558	219	646	1,061	1,040	746	774	800	1,426	1,221	1,327
August	273	932	388	352	249	401	1,437	1,549	1,002	1,085	1,590	1,664	1,103	888
September	292	970	319	249	160	280	1,197	1,574	1,936	935	1,097	1,388	1,528	1,368
October	282	1,732	374	155	409	340	424	630	1,642	1,053	1,558	1,209	1,339	1,300
November	305	306	298	162	447	454	304	768	577	469	1,791	626	1,322	588
December	184	1,044	968	248	120	523	303	381	603	905	1,238	491	721	494
TOTAL yr	**6,218**	**15,960**	**12,850**	**8,032**	**5,972**	**17,697**	**14,396**	**16,586**	**17,228**	**15,097**	**17,605**	**24,061**	**18,856**	**17,190**

14 Year Cold Mix Study-City of Lexington, KY

The makers of UPM mix
Unique Paving Materials Corp.

High Performance Cold Mix (HPCM)
compared to Conventional cold mix (CCM)



60% annual saving by reducing re-patching.

14 Year Cold Mix Study-City of Lexington, KY

The analysis required normalization of cost over the fourteen year program. HPCM was $122 per ton and CCM $112 per ton, a $10 per ton difference.

Annual repair material usage ranged from 150 to 602 tons per year. Labor and equipment cost per pothole was calculated at $29.20.

Repair material cost per pothole was $3.05 for HPCM and $2.80 for CCM.

The analysis identified a $0.25 material cost increase per pothole using High Performance cold mix resulting in a 60% reduction in potholes and $340,256 in annual savings, relative to conventional cold mix.

The reduction in potholes contributing to the total repair savings are the result of increased survivability (material staying in the repair) or less re-repairs, using HPCM.

Cold Mix Repairs Cost? (auto calculation)

Components of Total Cost	UPM® mix Initial Repair	UPM® mix Re-Repair	Competition Initial Repair	Competition Re-Repair
Cold Mix price , $/ton	$122.00	$122.00	$100.00	$100.00
Cold Mix usage, total tons/Year	450	9	450	239
Cold Mix usage, tons/month	38	1	38	20
Cold Mix pounds/pothole	50	50	50	50
Cold Mix Survivability	98%	98%	47%	47%
Labor Cost per person, $/hour	$28.00	$28.00	$28.00	$28.00
Men per Cre				
% of Total Cost Poth				
66%				
25% Equi				
9% M				
Total				

Functional Excel model available upon request.

66% Labor Cost/Pothole,$

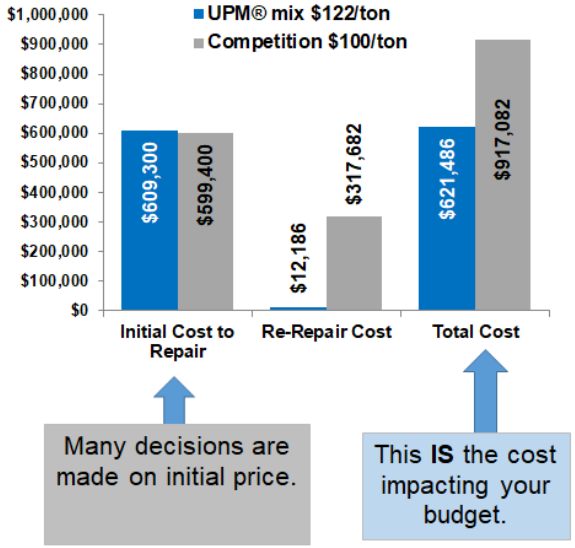
25% Equip/Fuel Cost/Pothole, $

9% Material Cost/Pothole,$

SUMMARY:

>In the above example, 1 ton of UPM® mix is equal to 0 tons of competitive cold
>Repair material is less than 10% of the repair cost. But can significantly increase
>The 32% reduction in potholes reduces exposure to traffic.

Cold Mix Source	Initial Cost to Repair	Re-Repair Cost	Total Cost
UPM® mix $122/ton	$609,300	$12,186	$621,486
Competition $100/ton	$599,400	$317,682	$917,082
TOTAL Saving with Premium mix			$295,596
Saving			32%



The TOTAL cost of cold mix repair is what impacts the budget,
NOT the cold mix material cost.

<u>Material cost is the smallest the contributor</u> to overall cost; 9% of the dollars.

The SHRP study

The SHRP Study was the most extensive pothole study ever conducted.

Beginning in March 1991, 1,250 pothole patches were placed at eight test sites across the United States and Canada as part of the SHRP H-106 project.

These patches were placed using different proprietary, state-specified, and local cold-mix patching materials and several different installation techniques.

The goal was to determine the optimum combination of materials and procedures for improving the cost-effectiveness of patching operations.

SHRP Recommendations

"Utilize the best materials available to reduce re-patching.

The cost of patching the same potholes over and over because of poor-quality material quickly offsets the savings from purchasing a less expensive cold mix.

In most cases, the poorer performance associated with inexpensive cold mixes will result in greater overall costs for patching because of increased costs for labor, equipment, traffic control, and user delay."

"The throw-and-roll technique was as effective as the semi permanent procedure for the same materials when the two procedures were compared directly."

"The SHRP H-106 project is the most extensive pothole-patching experiment ever undertaken."

Summary

- Use a premium cold mix even though more expensive to purchase, saves money.
- Use proper installation procedure.
- Premium cold mix patching is a proven cost-effective maintenance tool for emergency and long term repairs.

Thank you!

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