



▲ **Classic “throw, roll and go”** patching is a time-honored, if hoary, solution to pothole repairs.

Photo courtesy of City of West Lafayette, Ind

The Preservation Curve

High-Tech Materials, Mobile Equipment Can Keep Potholed, Cracked Pavements in Use Longer

Until driver complaints spur reaction, or that it becomes apparent that the pavement has decayed so much that the pavement’s no longer worth remedial maintenance spending.

By that time it will be no longer worthwhile to put any more money into the pavement to attain a serviceable condition. Having fallen off the “preservation curve,” during which maintenance funds will substantially extend the pavement’s service life, the pavement will have to be rebuilt at much greater expense than if periodic preservation had been provided (*see chart*).

Fortunately, a variety of pavement preservation tools exist – among them, new high-performance patch materials for asphalt and concrete pavements and self-propelled pothole patching machines – that are making the preservation of potholed and distressed pavements, well, less distressful.

Pothole Patching Today

Historically, filling potholes might have needed a truck and a crew of maintenance workers, who would place a few tons of material per day. The “throw, roll and go” paradigm – in which workers toss shovels of hot- or cold-mix asphalt into a pothole, the rear tire of the truck backs over the pothole,

and everyone moves on to the next pothole – no longer need be the norm. That's because new methods automate this process with great improvements in productivity.

At the same time, the longevity and quality of pothole patch materials has gotten better. And with mobile patching equipment, even though more expensive equipment is required, agency work forces no longer are exposed to traffic in a moving work zone.

With higher cost materials, pothole patching should be considered an investment, rather than a quick fix. The material used should be selected on the basis of where a pavement fits into a pavement inventory and pavement management system (PMS). If a pavement is so far gone that it is ready for reconstruction, the least expensive material likely is the best for emergency repair.

Ultimately, the issue boils down to available funds. The road industry and owners know how to build long-lasting roads, but they usually don't have the funds to build the longest-lasting pavement. Instead, a road may not be constructed to optimal standards, and then the pavement may not be maintained in a timely manner that will prolong pavement performance. Potholes and other surface distresses can be the result.

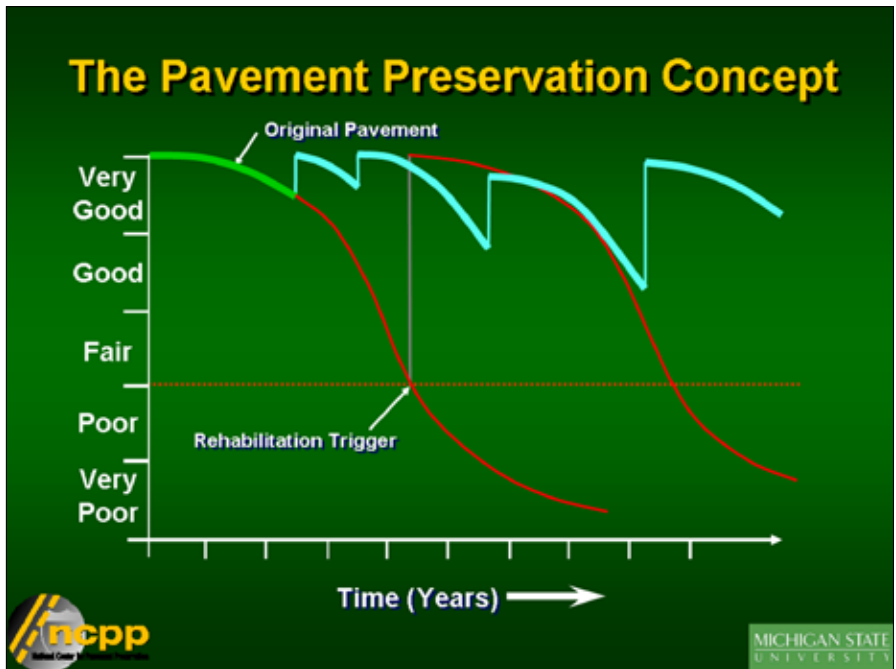
The right choice of patching material should be determined after study, because pothole repairs should be an engineered process. Emergency repairs may use a material – such as hot- or cold-mix asphalt – that can hold for 48 hours to three months, perhaps until late spring. But other materials, when cured, can be far stronger than the existing pavement matrix, with the possibility that the pavement can disintegrate from around the patch, with the patch material still intact.

What is a Pothole?

The Federal Highway Administration defines a pothole as a bowl-shaped hole in the pavement surface, of various sizes, with a minimum width of 6 in. Low-severity potholes are less than 1 in. deep, moderate from 1 to 2 in.

Patching will work only so long; this county road in central Illinois will receive a complete foamed asphalt recycling.

Photo courtesy of Dunn Companies, Inc.



▲ By applying pavement maintenance at frequent intervals, existing pavement (green) condition can be prolonged over many years (blue), as opposed to letting the pavement decline over years to a point where major expenditures are required (red).

Photo courtesy of the National Center for Pavement Preservation

deep, and high severity greater than 2 in. deep.

Potholes in asphalt pavements always are associated with HMA fatigue damage and water damage, and the worst potholes appear in late winter or early spring, depending on the climate, after a series of freeze-thaw cycles.

As Sunbelt agencies will attest, cold winter climate isn't necessary to form potholes. Water enters the road base through surface cracks or from the sides of the road, and water can be-

come trapped in small voids beneath the pavement surface. This water saturates and compromises the base. As vehicles run over the surface and the saturated base material, the unsupported surface layer is forced down, displacing the saturated layer and causing a hole. This hole gets larger as vehicles strike the hole and begin to pull existing pavement out of the depression.

But icy weather exacerbates the pothole. During the winter the wa-

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ter freezes, which draws more water into the base material. February and March freeze/thaw cycles result in frost heaves, which let in more water. Then the ice melts from the top down, leaving a trapped pool of water. Again, traffic strikes the hole and breaks it open.

The time that the worst potholes appear is not the best time to be making permanent patches with conventional materials such as standard hot or cold mix asphalt. But use of high-performance bonding agents or patching materials can result in a durable patch whether the hole is wet or the patch is executed in below freezing temperatures.

Choices of Repair Materials

Most agencies have three types of cold mixes available to them, reports the FHWA in its guide, *Materials and Procedures for Repair of Potholes in Asphalt-Surfaced Pavements: Manual of Practice* (Google FHWA-RD-99-168). "The first of these is cold mix produced by a local asphalt plant, using the available aggregate and binder, usually without an opportunity to consider compatibility or expected performance."

Use of such a mix in late winter or early spring would probably be a stop-gap measure until weather improves. In winter such material congeals and is not easy to work with, while in summer the material is fluid and sticky.

"The second type is cold mix produced according to specifications set by the agency that will use the mix," FHWA said. "The specifications normally include the acceptable types of aggregate and asphalt, as well as acceptance criteria for the agency to purchase the material. The aggregate and asphalt usually are tested for compatibility before specifying acceptable sources."

The use of pothole repair spray-injection equipment (see below) by agency forces would fall into this category, as the agency must check the asphalt-aggregate compatibility before placing patches, FHWA said.

"The third type is proprietary cold mix," FHWA said. "A local asphalt plant generally produces this material using

specially formulated binders. These binders are produced by companies that test the local aggregate, design the mixes, and monitor production to ensure the quality of the product. These materials (like other cold mixes) can be produced in bulk and stockpiled, or they can be packaged into buckets or bags to make the material easier to handle in the field."

Spray-injection patching performed by a contractor would fall into this third category, as the aggregate and binder are supplied by and should be tested by a patching contractor, FHWA said.

Premium National Brands

High-performance premium national brands constitute another type of cold patching material. One such proprietary cold mix product is UPM Permanent Pavement Repair Material from Unique Paving Materials Corp. This high-performance material, the manufacturer states, can be applied any time of the year in any kind of weather conditions, including wet and freezing.

For application, an application area should be swept of debris. The material then is shoveled or poured into the pothole from bags, pails or drums, and compacted. No primer or tack coat is required, UPM says.

UPM claims that over 90 percent of repairs using its product will outlast the surrounding pavement. The product is supplied in seasonal grades, matched to local aggregates, with specific formulations to accommodate year-round patching needs. And as it's supplied premixed, UPM says, there is no need to visit the asphalt plant and wait in line.

A competitive product is HP Asphalt Cold Patch from Crafcoc Inc. HP is approved as a high-performance patching material in most states, and other user agencies, within the United States, Crafcoc says. Like the UPM product, HP is specifically formulated for the wide-ranging temperatures and climates of its market areas. This permanent repair works in all weather conditions; wet, cold or hot, the maker says.

HP is supplied in bags, and no mixing, mechanical compaction or tacking is required. The material, Crafcoc

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says, permanently adheres to asphalt, concrete or steel, thus is applicable for bridge, drain, utility cuts and cutter work. The patch can be opened to traffic immediately, the manufacturer says.

Bonding Agents for Wet Conditions

If a lack of funds forces an agency to eschew proprietary mixes, and use conventional cold mix asphalt to patch potholes, it has the option of using a sprayed bonding or contact agent to ensure attachment to the wet substrate.

One such product is Bondade from Transpo Industries, Inc. Bondade is a solution which promotes adhesion of asphaltic materials to a variety of substrates. The coupling agents in Bondade markedly extend the working life of asphalt repairs by securing a firm, water-insensitive bond between repair asphalt and the base materials, Transpo says. "Bondade should be used whenever new asphalt or bituminous concrete is applied to either concrete, asphaltic surfaces or potholes," the maker adds.

This bond will last up to 85 lon-

ger than conventional methods, the maker says. It's an environmentally safe "green" product which is non-toxic, non-flammable and non-combustible, and contains no volatile organic compounds. It's indicated for hot and cold patch repairs, damp or dry holes, overlays, cold joints between lanes of HMA, and emergency repairs, Transpo says.

Spray-Injection Uses Crew of One

A step up from the truck-and-crew methods are the self-propelled units. The spray-injection patching process using a mobile unit reduces personnel used to one worker. For example, with the Rosco RA-300 unit from VT Lee-Boy, Inc., one person controls all patching functions from the cab.

This hydraulic "patch-on-the-go" system permits patching of large numbers of patches on the move in a single day, with no auxiliary power. The driver operates a joystick from the driver's seat and performs a four-step process, typically in less than a minute per repair, the maker says.

During the patching process, a robotic patching boom extends and retracts while on the move, with the operator's joystick controlling boom movement. At a repair, the pothole is cleaned with a high-volume blower, and a tack coat of emulsion is sprayed. A mixture of aggregate and hot emulsion then is injected into the pothole, which is followed by a finish coat of dry aggregate. Traffic can resume at once.

On the Rosco RA-300, a pressurized flow system minimizes maintenance with only one moving part, the maker says. Delivering the air, aggregate and emulsion needed in the spray patching process is a low pressure (3 to 4 PSI) system that keeps material flowing into the air stream and eliminates the need for moving parts. A 5-cu. yd. aggregate hopper and 400-gal. emulsion tank allows the unit to patch for days, requiring only occasional aggregate fills.

Lower Costs with Patch Trucks

While less sophisticated than the robotic spray-injection units, an all-in-

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one pothole patch truck may help an agency lower personnel costs associated with pothole repair. For example, the Town of Irondequoit, N.Y. is aggressively fighting potholes using a self-propelled electric-heated pothole patching truck that has improved road conditions while optimizing safety and cutting costs.

"It's very important that the taxpayers of this town are pleased with the services we provide for them," said Jeff Graves, labor foreman for Irondequoit Department of Public Works. "We are a diverse and established town, and nobody likes to drive over or around potholes. Our flameless pothole patcher has proven to help us keep up with the volume of potholes and has significantly increased our patching quality."

In the winter months, when HMA wasn't available, Irondequoit used a cold-patch material and the throw, roll and go method. When HMA was available, the town would travel with just enough material to fill the open excavations and major patching areas. But the HMA would cool quickly and at



▲ **High-performance, proprietary repair materials** can be placed in cold, wet conditions and still perform to spec.

Photo courtesy of Unique Paving Materials Corp.

times the crews were not able to use all of the purchased asphalt.

The town looked for a more efficient method to preserve the hot asphalt. Irondequoit had used a propane-operated patching unit, but when it was time to replace the unit, Graves looked elsewhere because he wanted

something that could keep the asphalt material warm for a longer period of time. The town settled on purchasing an FP5 Flameless Pothole Patcher from Bergkamp, Inc.

The most significant element of the new unit is the electric-heated hopper

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that keeps the asphalt material warm while the unit is in motion or stopped. It uses an onboard hydraulic-powered AC generator to heat its insulated 5.1-cu yd hopper, and keeps the material at a consistent temperature throughout the day.

In addition, Graves and his crew use the tools on the unit to follow a process for most potholes. The damaged pothole area is squared off using the hydraulically driven pavement breaker. The old material is then removed and placed into one of the spoils bins, located on the side and rear of the truck so workers can safely stay out of traffic's way.

The combination compressed air and tack coat wand blows the remaining debris out of the pothole. The same self-cleaning wand then applies the warm tack coat. The ability to dispense warm tack coat in any weather condition has been a huge factor in prolonging the life of Irondequoit's repairs.

An auger dispenses material onto the swivel material chute, which delivers the fresh, hot asphalt to the prepared area. The chute slews left or right, allowing for multiple pothole and shoulder repairs from one location. Finally, a hand-operated plate compactor – or single-drum roller – will vibrate and compact the material flush with the existing pavement.

Graves estimates he is saving up to 10 man hours some weeks producing new patches, instead of performing repetitive repairs. The town has also lowered material costs. With the propane-operated pothole patcher, the town was unable to productively use approximately 10 percent of the hot asphalt material purchased per week. At an average of \$67 per ton last year, the town saved approximately \$200 per week.

In addition, by making fewer trips to the asphalt plant, the town saves on diesel fuel costs, wear and tear on the equipment and has increased on-the-job productivity. And Graves doesn't have to worry about purchasing costly heating oil or propane anymore. He just turns the unit on and the onboard hydraulic-powered AC genera-

tor provides power to the full length electric-heating elements. The elements produce a consistent heat from the front to the back of the patcher, eliminating hot spots and the need for heating oil.

Infrared Offers Option

A different approach to permanent patch repairs is the infrared option. Distressed pavement surface repairs – such as potholes, alligator cracking, bird baths, high spots, pavement seams, manhole covers or failed repairs – may be effectively fixed using the infrared process.

Seamless infrared asphalt repairs are achieved by using specialized equipment to heat the existing asphalt surface to a depth of up to 3 in. New hot mix asphalt is then mixed with the existing asphalt, forming not a patch, but a seamless repair that is thermally bonded to the surrounding asphalt. After a slurry or chip seal, the repair likely will not be detectable.

The seamless repair will resist water intrusion, can be performed in any weather conditions or temperatures, and can be opened to traffic in an hour or less in most cases.

After a repair area is cleared of broken and raveled asphalt, an infrared heater is positioned over the repair area, which is then exposed for up to 10 minutes. After the asphalt is softened – but not scorched – a lute or rake is used to define the outer edges of the patch. At least 6 in. of the heated surface should remain undisturbed around the outside edge of the patch, contractors say. The rake



▲ As illustrated in these pictures (from top to bottom) existing damaged pavement; repair is squared, cleaned of debris and tacked; final repaired pothole.

Photos courtesy of Bergkamp, Inc.

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is then used to scarify the inside of the hot patch area and an asphalt rejuvenator is mixed with the raked, aged asphalt.

Then, fresh virgin asphalt is added to the site to bring the repair up to grade. The patch is then leveled with a lute and the area around the repair is swept clean. Compaction flush with the surface completes the infrared repair.

Concrete Pavement Repairs

Spalled concrete caused by fatigue, freeze/thaw cycles, warping stress, ingress of water, or substrate problems can lead to costly reconstruction, and repairs require a different approach than with flexible pavements. But patching of portland cement concrete pavements with conventional PCC – with its long cure times and lane closures – can cause excruciating user delays, whether on an expressway or airport runway.

As conventional rigid cement repairs – such as epoxies or fast-curing

cementitious products – often fail due to de-bonding, fatigue and differential expansion characteristics, additional cracking and the need for repeated repairs may occur. Instead, a variety of high-performance concrete patch materials provides quick repairs that not only cure very fast, but solve long-term patch durability issues.

For example, TechCrete from Crafcro provides a long-term solution for distressed concrete pavement preservation, the maker states. It's a hot-pour repair solution which provides flexibility, high tensile strength, ability to bridge joints and high compressive resistance, the maker says.

Once in place, a TechCrete patch will move with the pavement and will not de-bond or crack, Crafcro says. The product also has a high friction surface ideally suited for thin bond repairs, multi-corner slab repairs, joint intersection repairs and recessed applications. Repairs with Crafcro TechCrete can be opened up to traffic within as little as one hour.

Another product, Rapid Set from CTS Cement Mfg. Corp. is a specialty cement which gains structural strength in 1.5 hours after placement, materially reduces drying shrinkage, and reduces porosity for enhanced durability. It results in a workable, 5-in. slump concrete that gains compressive strength of 2500 to 3000 psi in 1.5 hours. The shrinkage of Rapid Set concrete is about 25 percent of the shrinkage of same slump portland cement concrete (PCC).

Its improved durability by reduced porosity is demonstrated by superior freeze-thaw resistance, the maker says. This attribute makes it ideal for placement where speed and durability is of the essence, for example on night patching on urban expressways or bridge decks, or night runway repairs at major airports, where liquidated damages for failure to open can run into the tens of thousands of dollars. ❖

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