

# Fresh take on pothole patching and prevention



*Timely crack sealing and other surface treatments early in the life of a pavement help prevent moisture from seeping beneath the surface and undermining pavement strength.*

**WHEN WINTER MELTS** into spring, it leaves behind rough roads and needed repairs. This year is no exception as local highway and public works departments face another bumper crop of potholes.

The pothole-patching season raises a few questions. What is it about severe cold and snow that produces potholes? What basic fixes do local “patching patrols” follow and what newer options are they using for long-lasting repairs—especially in tight-budget times? Finally, what does it take to keep potholes from forming in the first place?

## Pothole pathology

Motorists tend to label any pavement distress as a pothole when, in fact, a genuine pothole is a bowl-shaped hole of broken pavement caused by fatigue at and beneath the surface.

Inadequate pavement structure often is behind chronic pothole problems. Low-quality materials, poor compaction, water-saturated underlying soils or inadequate pavement thickness can result in substandard pavement easily affected by conditions.

Good road or bad, severe winter weather and the spring thaw push pavements to their limits. Drainage, moisture seeping through fatigue cracks, freeze-thaw cycles and damage from loaded trucks all accelerate pothole formation. The harsher the winter, the heavier the snowfall, the more cycles a road endures.

The life cycle of asphalt pavement materials also plays a part. As asphalt ages, it becomes brittle. Cracks form more readily from the combined forces of traffic, nature and maintenance. Now less flexible, the pavement allows moisture to permeate its surface and speed deterioration.

In the freeze-thaw cycle, water in the pavement structure expands



as it freezes and, as temperatures fluctuate, the water thaws and freezes again. Through repeated cycles, the pavement heaves and cracks. Many winter maintenance activities, such as sanding and salting operations that keep roads open during and after storms, contribute more stress to this sequence of events.

## Distinguish one hole from another

The classic pothole carries through all pavement layers, from the pavement surface to the sub-base and soil. It can grow to several feet wide and several inches deep.

Other distresses that resemble potholes occur when there is delamination (also called debonding) of the top pavement layer(s) due to a poor bond between layers. When localized, this condition produces a pothole-like hole, but it penetrates only as deep as the layer where pavement lifts did not bond. Inadequate sweeping and cleaning of the surface before overlay, an inadequate tack coat, moisture on the pavement at the time of paving or poor compaction in the surface layer also causes delamination.

A fresh look at typical fixes for potholes demonstrates the options available to local road maintenance operations and how to make those fixes last.

## Better performance from temporary patches

Many potholes require an immediate fix to make the roadways safe to drive and prevent vehicle damage. Temporary patching is the general rule when repairs are necessary in cold and snowy weather or during spring melt-off and rain. Highway departments often use a cold-patch asphalt mixture for temporary fixes because hot-mix asphalt is not available in the winter season.

Even if the patch is temporary, it pays to follow patching procedures designed to get as much life as possible out of the patch. Patches made using the “throw and go” method do not perform well. Where road crews place loose cold mix in an unprepared pothole and rely on vehicle traffic to compact the material, they can measure patch life expectancy in hours or days rather than months or years.

Studies show the performance of a temporary patch improves significantly with a “throw and roll” approach. Throw and roll calls for placing cold-mix material in a hole (even one filled with water and debris) and compacting the patch by four to eight passes of the road crew’s truck tires. If the center of the patch remains depressed after compacting, the crew adds more patching material and re-rolls it so the patch is

slightly crowned from center to edge; traffic then supplies added compaction. Removing water and loose debris from the hole before patching is a simple added step that further increases patch life.

### Effective semi-permanent patching

A semi-permanent patch is a more complicated method for repairing potholes on roads or streets. This approach is similar to a full-depth hot-mix asphalt patch except it uses cold-mix material. When installing this kind of patch, maintenance crews generally:

- remove water and loose material from the pothole
- cut pothole sides so they are vertical and square with sound pavement on all sides
- place the patching material, using a lift if the asphalt is more than three-inches deep
- compact the patch with a vibratory plate compactor or roller.

Another patching choice that produces a long-lasting fix in adverse conditions is spray injection patching. This involves a specialized truck- or trailer-mounted system that includes an emulsion tank, aggregate hopper and air compressor. The process first uses compressed air to blow water and debris out of the pothole. Then operators spray an asphalt emulsion mixed with aggregate into the pothole in layers, placing a layer of aggregate on top of the patch to keep the material from tracking under traffic. In practice, this process produces "temporary patches" that last three to five years.



*Spray injection patching works well under adverse conditions and produces long-lasting temporary patches.*

### A good cold patch

As with road construction, good materials contribute to performance of the patch or surface treatment. Since most pothole repairs depend on cold-patch materials, what is the basis for a good cold patch?

- workable in low temperatures
- stays workable in a stockpile over a period of several months
- stable under traffic, does not shove or rut
- sticks in wet potholes without tack coat
- remains on the aggregate, does not "strip" from the action of water
- compatible with hot-mix asphalt when paved over at a later time

Experts recommend using clean crushed aggregate with less than 2 percent fines (passing through a No. 200 sieve) and a maximum size of three-eighths to half-inch for a successful cold-mix material. Use anti-stripping additives and polymer-modified asphalt to improve performance further. Some proprietary cold-patch products have proven effective, but a non-proprietary mix using the right materials also works well.

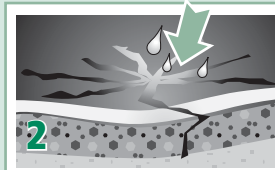
### Preventing potholes an ongoing effort

Pavements deteriorate at different rates for many environmental and structural reasons. Close attention and regular inspections serve as a check on potential pothole problems. It gives officials responsible

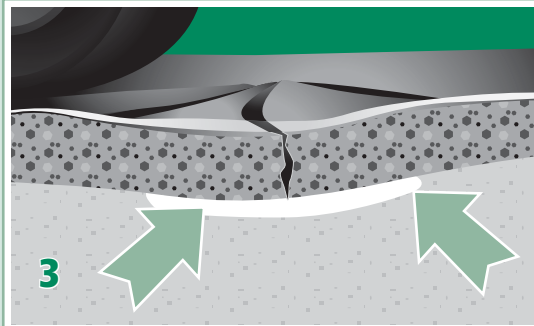
### How a pothole forms



**1**  
**Vehicle weight** causes pavement to bend slightly.



**2**  
**Small cracks form** on the underside of the asphalt first then on the surface where rain and melted snow seep in. The moisture expands when it freezes, creating deeper, wider cracks.



**3**  
**Multiple freeze/thaw cycles** and constant vehicle loading cause cracks to penetrate the pavement, letting moisture seep below the surface. As this moisture expands with freezing, it pushes the pavement up and weakens it further. After melting, the ice leaves a cavity.



**4**  
**Vehicle traffic** eventually compresses the weakened pavement over the cavity and the crack becomes a pothole.

Adapted from Minnesota Local Road Research Board video.

for local roads the data they need to take appropriate preventive measures. Timely crack sealing and other surface treatments early in the life of a pavement help prevent moisture from seeping beneath the surface and undermining pavement strength.

Potholes happen. Local officials need effective patching methods in their arsenal to restore winter-weathered roads. But an ongoing effort to maintain good roads in good condition goes a long way to minimizing the impact of pothole season. ■

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