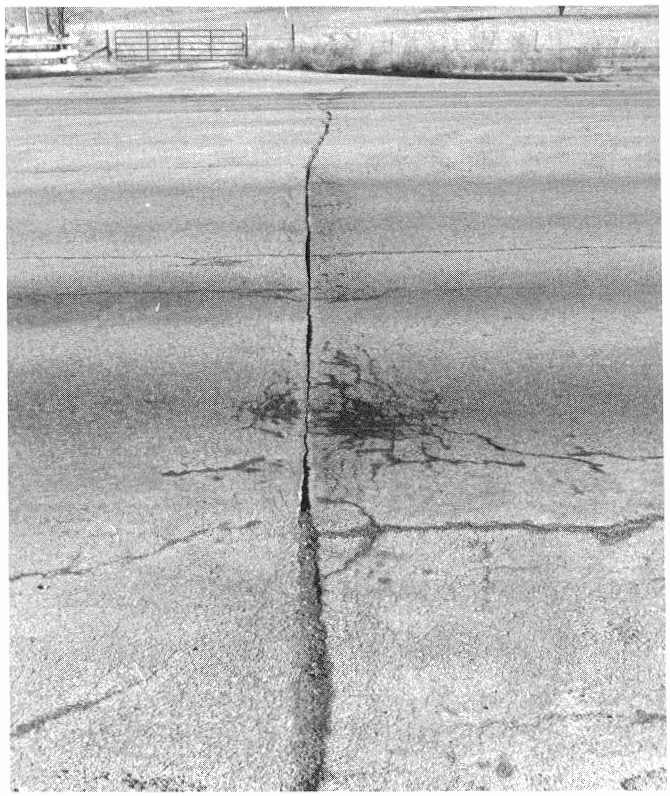
A Crack Sealed in Time Saves Nine

Of the 2 million miles of asphalt roads in the United States, most show signs of cracking. While some areas have extensive crack sealing programs, many public agencies still view crack sealing as an ineffective, low-priority item.

As a result, many miles of roads go unsealed every year, allowing moisture to enter and pavement deterioration to accelerate. Combined with traffic and other environmental factors, this leads to quick destruction of our roads.

When a crack occurs in the surface course (top layer) of an asphalt road, moisture enters and slowly works its way down to the base. As the base is eroded, the pavement begins to sink and crumble, causing more cracks to form.

This process will eventually create potholes. In cold climates, this process is accelerated by freeze/thaw cycles. Pockets of water trapped in the cracks and under the surface freeze and expand, and the expansion causes the pavement to shift and deteriorate further.



A hot crack sealer should be used on this large crack.

Successful crack sealing starts with a sound understanding of the different types of pavement cracks and their causes. Being able to identify the type of crack and knowing its cause enables you to correctly solve the problem and extend the life of the pavement. Below is a list of the types of cracks and their causes.

Reflection Cracking—occurs primarily in resurfacing projects but can occur when the soil subgrade dries and shrinks.
Joint Cracking—is found along the joint where bond failure has occurred because of improper luting, compaction, or too much or too little overlap.
Slippage Cracking—is generally caused by a poor bond between the asphalt concrete and the original pavement. Too heavy or improperly cured prime or tack coat, too light a tack coat, paving over a dirty or wet pavement, too much liquid asphalt cement are all construction factors that cause a poor bond. Other factors that cause slippage are a soft subgrade or traffic loads that exceed design limits.
Thermal Cracks—result when pavement is constructed with too small a percentage of air voids, which provide the pavement's internal stress relief system.
Fatigue or Alligator Cracking—occurs when the asphalt concrete loses flexibility and is less able to tolerate minor deflections. As the asphalt ages and oxidizes from sun, rain and air, it starts to become rigid and cracking results.
Block Cracks—are found mainly on low usage roads and parking lots. Without the traffic to keep the asphalt pavement flexible from use, the pavement becomes brittle and breaks in block patterns that intersect one another at right angles.
Edge Cracking—is generally parallel to and within 18 inches of the edge of the pavement. It is generally caused by a poor base, lack of shoulder support, poor drainage or frost action.

Knowing the types of cracks and their causes should help you take preventive measures during construction that might reduce the number of cracks to a new pavement. Now that you know what causes certain cracks, you are ready to begin making repairs. Your next considerations will be when to repair and what materials to use.

Choosing the best season

The time of year crack sealing is done dramatically affects the success of your efforts.

In the summer a crack is narrow due to the pavement expansion and if filled at this time the seal will be under excess tension in winter. Tension on the sealant could result in the seal being torn away from one side of the crack.

On the other hand, crack sealing in the winter causes the seal to bulge in the hot summer months.

Crack sealing in the spring or fall is best because the pavement is not fully expanded or contracted. This results in a slightly compressed seal in the summer and a seal in slight tension in the winter (see related diagram).

quality arises, you can have the samples tested, although you should recognize that the "shelf life" of a rapid-setting asphalt emulsion is only a few weeks. Furthermore, just taking the samples, when the supplier is watching, will keep them on their toes.

Success is a team effort

We have reviewed five aspects of chip seal work where things often go wrong. Extensive failures can occur for a single reason, for example, constructing in cold, wet weather. However, usually they result from a combination of the problems discussed.

The range of problems mentioned cannot be prevented by a single "superman" foreman or highway superintendent. Perhaps the best way to ensure a quality product every time is through team work. Everyone on the job must know what the finished product should look like. They must know what their work mates are responsible for. Then everyone can help each other to get the job done right.

Chip seal planning and training sessions can build such a team.

References for further reading

- "A Basic Asphalt Emulsion Manual," Asphalt Institute, Manual Series No. 19, Second Edition
- "Surface Treatment Manual," Chevron, Chevron USA, 1985

Reprinted with Permission from Nuggets and Nibbles *of the Cornell Local Roads Program*

Sailing Through the Big Three

by Jorge N. Villacres, District Engineer, Asphalt Institute

Most counties and cities have experienced various levels of failure with surface treatment (primarily chip seal) operations.

Surface treatments, such as chip seals, are generally best suited to low and medium-low volume traffic roads. Chip seals, in particular, are subject to a shortened life by high-speed and high-volume traffic. Cold and damp weather severely reduce the chance of success in surface treatment operations.

However, surface treatments are an excellent and economical method of sealing a surface to prevent the entry of water and air into the pavement below. Surface treatments improve the properties of the existing surface by filling in small cracks and adding needed asphalt to an oxidized surface. Additional benefits include improved skid resistance and reduced reflective cracking.

This article discusses three problems often encountered with chip seals.

Loss of aggregate

The most frequent causes of loss of cover aggregate are failure to apply aggregate immediately after the emulsion is sprayed and failure to roll the aggregate immediately after spreading. The aggregate needs to be placed onto the emulsion before it breaks or it will not adhere properly. Rolling of the aggregate sets it in place for maximum adhesion and needs to be done right away.

Use of dirty aggregate—with too much dust covering it—tends to reduce adhesion of the asphalt to the aggregate and leads to loss of the aggregate. Failure to prepare the pavement surface before chip sealing causes substantial to spotty loss of aggregate and a generally poor-looking job. Structural failures, such as alligator cracking, must be repaired and large cracks need to be filled prior to the operation. The pavement needs to be clean and free of loose debris. Use of an insufficient amount of asphalt emulsion also will cause loss of cover aggregate.

Bleeding is caused by too much asphalt, using too small an aggregate size, an unexpectedly high volume of traffic or high traffic volume and a long-graded aggregate. The long-graded aggregate tends to lose void space over time—even more quickly with high volume traffic—thus pushing the asphalt to the surface. The best aggregate for chip seals is that which is as near all the same size as possible and as much cubical shaped as possible.

Streaking is caused by improperly set or improperly functioning nozzles on the asphalt distributor. The resulting coating of asphalt has longitudinal streaks of insufficient material which will not hold the aggregate. Not only do asphalt nozzles on distributor spray bars need to be in good working order, but all equipment must be properly calibrated and in good working condition.

Other aspects of chip sealing include selecting the proper types and quantity of asphalt emulsion and the proper size and quantity of aggregate. This is called chip sealing design.

This excerpted article appeared in The Link, *a newsletter published by the Kentucky Transportation Center.*

APWA Awards

Contd. from page 1

Also recognized as one of America's top ten Public Works Leaders was Jerry E. Petty, Director of Community Development and City Engineer for Manhattan, Kans. His accomplishments included the successful oversight of a significant downtown redevelopment project and most notably, his leadership during the 1993 flood.

As reported by APWA, "For two weeks, Petty provided engineering support for sandbagging efforts and operation of a remote office in a garage in one of the heaviest hit subdivisions in the city. He and his crew operated the makeshift center 24 hours a day, until they became victims of their own evacuation notice. Their personal, hands-on approach served the citizens of Manhattan well and resulted in selective and timely evacuation of nearly 700 homes."

We are proud of these accomplishments and applaud the good work done by Jerry Petty and Cornejo and Sons, Inc.

Taken from the APWA Reporter, *May 1994.*

Choosing the best materials

Transverse and longitudinal cracks can be repaired with either hot or cold materials depending on the condition of the crack. Before selecting materials, consider requirements such as adhesion, resistance to softening, flexibility, pot life, weather resistance and cure time.

A key factor in deciding between hot and cold crack fillers is the size and types of cracks. Generally, hot crack sealers seem to perform better in cracks a half-inch wide or larger and still expanding. Hot crack fillers have difficulty penetrating small cracks because of the material's high viscosity and rapid cooling rate. Hot crack fillers are best suited for large longitudinal, large transverse, and large reflective cracks.

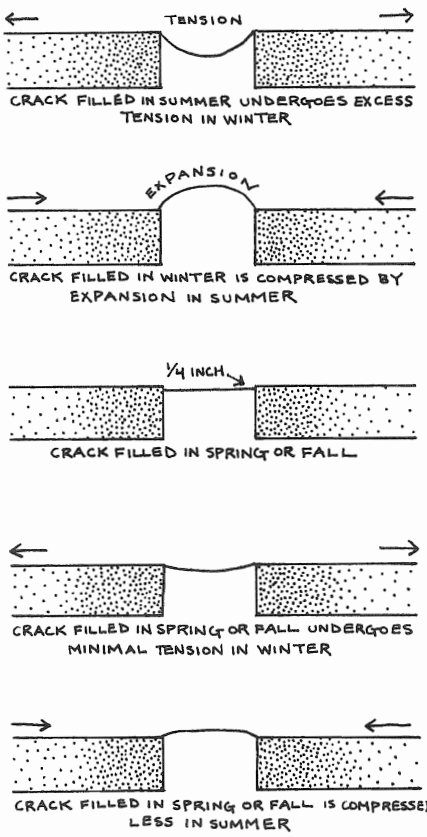
Many cold, pourable crack fillers are also available. These do not require a kettle or double boiler, saving equipment expenses and increasing productivity since no down time is required for heating. Most pourable crack fillers are emulsion-based asphalt with various additives such as rubber and latex fillers.

During the last few years, the quality of cold crack sealers has improved, and they now provide a quick and easy way of sealing pavement cracks. Cold crack fillers seem to work better in smaller cracks less than a half inch wide. The lower viscosity of the cold material allows more time to penetrate the pavement. This property makes it best suited for small reflective, small transverse and small longitudinal cracks.

Before beginning a crack filling program, conduct a pavement evaluation to determine the type of material required. Be sure to consider the pavement type, crack size and types, personnel and equipment available, and whether to use a hot or cold material.

The decision to start a crack filling program is a major step in pavement rehabilitation that will dramatically increase road life.

This article was adapted from an article in The Wheel, *v.8, #13, 1994.*



Practice Preventive Maintenance, Not Crisis Repairs

by Heather Edison Benson

Pot hole repair is an annual event every spring and summer in the Midwest. Because of the extremes in weather, our roads take more of a beating each year than do those in states with fair climates. Two things most detrimental to pavement are water and traffic that is too heavy for the pavement. Water that seeps into cracks in the road or along the side of the road will soften the sub-base. Precipitation that gets into the sub-base causes oozing and shifting of the material under the pavement. In the early spring, freezing and thawing expands and contracts the loose subbase and forms a hole that breaks-in when traffic drives over it.

Traffic that is too heavy for the street design causes fatigue cracks. For example, when a street intended for light traffic becomes a route used by trucks, the pavement surface isn't thick enough to support the weight. After repeated trips over the pavement, cracks will break apart and develop into holes.

Communities wanting to break this cycle will have to exert enough political discipline to reverse their maintenance priorities.

The best way to prevent these problems are good construction, timely overlays, seal coats and crack filling. Also important is roadside weed trimming and ordinances that keep trucks off residential streets. These are the basics we are all familiar with. Probably the only thing preventing local government from having better roads are the allocation of funds to maintain them properly. Without financial support, city and county road crews can't practice preventive maintenance.

Tyranny of the Urgent

There are ways, however, to make improvements to roads without draining one's resources. A booklet by the American Public Works Association outlines an excellent course of action that can be used at any level of government for the maintenance of roads. "The Hole

Contd. on page 6

"HONEY! COME HOME! YOU CAN LOOK FOR THE CAR AGAIN TOMORROW..."

Preventive Maintenance

Contd. from page 5

Story" explains that patching and rehabilitating streets in "poor" condition may more than consume a city's existing budget. Meanwhile streets in good condition—but at a point where "timely" lower-cost maintenance is needed—get left unattended, causing them to enter the rapid-deterioration phase a few years later.

Communities wanting to break this cycle will have to exert enough political discipline to reverse their maintenance priorities. That is, good streets in need of routine maintenance will have to be ranked ahead of what might be termed failed or crisis streets when allocating the regular maintenance budget. Preventing good streets from slipping into disrepair will intervene in the chronic cycle. To bring these streets up to "good" condition, such that they can be maintained using lower-cost methods, a separate (new) budget will have to be expanded to the point that timely maintenance can be carried out on the entire street network.

Ten years ago Kansas adopted the strategy of repairing roads in reverse order as described above. After the first four years, quantities of aggregate and asphalt used for surface repairs and resurfacing were reported to be progressively lower each succeeding year!

The U.S. Army Corps of Engineers recently compared the maintenance practices of two army bases: one uses a pavement management system to help determine the optimum timing for maintenance and the most cost-effective strategies; the other base allocates its budget on the ad hoc basis of which roads were in the worst shape. Both bases had nearly identical budgets, yet an evaluation of the pavements of both bases (on a scale of 1 to 100) found that the first base had an average condition rating of 75 compared with the second base's average of 41.

Being dedicated to a maintenance plan is the best way to improve road conditions over time. This will make your jobs more efficient and motorists will be happy and safe.

For the rest of "The Hole Story," please write or call:

American Public Works Association
106 W. 11th Street, Suite 1800
Kansas City, MO 64105-1906
Tel (816) 472-6100,
Fax (816) 472-1610.

Pot Hole Repair

Resisting the Dump and Run Method

Pothole patching, also known as manual patching, is the repair of relatively small, pot-shaped depressions in the road or shoulder areas. The paving materials are pushed out of the depression by the force of traffic.

Potholes are filled for the obvious reason of improving the riding surface for the motorist. If potholes were not fixed, not only would motorists have a rough ride, but in a very short period the road would crumble. Moisture from rainfall is caught in the depression and filters into the stone base. The material in most municipal road bases is stone. The stone base is held together by the interlocking of the particles of aggregate and the friction between particles. Since water is a lubricant, its presence causes a loss of friction and consequently a loss of strength in the base material. This leads to further problems. Corrective measures would then require rehabilitating the road, which is very expensive.

Many municipalities use the "dump and run" method of patching. This is due to pressure to fill as many potholes as soon as possible.

The life of most of these repairs varies from a few hours to a few weeks. The repeated filling of the same potholes results in a large expenditure of shrinking public works funds. The most cost-effective technique for filling a pot hole is doing it right the first time!

When filling a pothole or a large deteriorated section of road, a road crew follows the same general steps used by a dentist when filling a tooth. The damaged material is removed, the area is cleaned, and the filling is put in place. Specifically, eight steps are followed when manually patching a pothole.

1. Work zone traffic control

Set up work zone traffic control according to the latest version of work zone safety rules in Part IV of "The Manual on Uniform Traffic Control Devices." Select the correct signs and/or flaggers for your situation and place them as required.

2. Marking

Mark the area to be patched. Markings tell the person cutting how much material to remove. It can be done with a straight edge or a chalk line. Marking too far from the edge wastes material. Marking too close to the edge leaves deteriorated material at the edge of the patch, inviting further failures. Marking a hand's breadth from the edge of the visibly deteriorated area is a good rule of thumb.

3. Cutting

Cut out the hole in a shape that provides vertical sides and even edges for better support of the patch. Any polygon shape will do as long as the edges are straight and the corners form angles. Cut from the inside of the pothole out toward the marked lines. This prevents jamming of the cutting blade as the loose materials fall away as you cut.

4. Cleaning

Remove all debris, damaged asphalt, dust and water from the hole. Any loose materials that remain in the pothole will prevent the new material from sticking to the bottom of the patch. Asphalt and water don't mix, so dry out the hole as much as possible. Hot asphalt placed in a wet hole will cool rapidly, preventing proper compaction. Recent studies by SHRP show that materials placed in a dry hole last two to three times longer.

5. Tacking

Apply a tack coat (a sticky asphalt liquid) to the inside of the hole to help hold the patch firmly in place. The tack material will seal the joint that will form when the hot asphalt is placed next to the cold existing material.

6. Filling

Fill the hole with patching material. Hot mix ID2 is the best patching material for a long-lasting repair. However, when this is not available, cold patching materials will work adequately if placed according to these eight steps.

When using hot mix, dump the patching material directly into the hole if possible. If you dump the hot mix on cold existing pavement, it will cool too rapidly. When the hot mix comes from the plant it is mixed at about 325 degrees. At this temperature, the liquid asphalt in the mix is acting as a lubricant, allowing the aggregate to slip together easily under the compaction equipment. As the hot mix cools, the asphalt stiffens and changes to a gluing agent, making proper compaction much more difficult. Spread out the material over the hole using a lute. Using a rake will cause the small pieces of asphalt-coated stones to separate and will further cool the mix.

Dedication to doing it right the first time saves money and time down the road for years to come.

How NOT to patch.

7. Compaction

Compact the asphalt using a small roller or a vibratory plate compactor. Make sufficient passes to allow for maximum compaction. Compaction must be done while hot mix is hot enough to allow the aggregate particles to densify properly. If the hot mix is too cold, proper density will not be reached. Make sure the area around the patch has been properly cleaned so your compaction equipment will not ride up on the excess material, preventing proper compaction.

First, pinch the material in the hole by rolling the edges of the mix. Next, roll the center of the patch, moving outward toward the edges with each succeeding pass. This helps force the mix tightly against the edge of the old pavement.

8. Clean-up

Clean-up, while not essential to the performance of the patch, does contribute to the public's perception of how you do your job. The edges of the patch can be sealed, but this is an option as the possible crack between old and new material has been sealed by the tack. If used, the edge sealer should be blotted with clean sand or screenings to prevent pickup by traffic. The excess material should be cleaned up and removed.

These eight steps are standard procedure that will ensure a good patch when followed. Dedication to doing it right the first time saves money and time down the road for years to come.

Adapted from the Pennsylvania Local Roads Program, Tech Sheet #64, April 1993.

Listen Up!

38th Annual Kansas Asphalt Paving Conference

On November 3, 1994, the University of Kansas, Lawrence, will host the 38th annual Asphalt Paving Conference. This is an event that a*nyone* involved with asphalt pavements would benefit from. The conference is designed for:

- Asphalt paving contractors, superintendents and highway construction personnel
- State highway engineers, engineering technicians and roadway maintenance personnel
- County and municipal engineers
- County/township road and maintenance supervisors
- Consulting engineers
- Asphalt paving and highway construction equipment vendors
- Material suppliers
- State, county, township and municipal transportation officials.

The conference agenda includes lectures, panel discussions and informal discussions on asphalt pavement-related topics from many perspectives. Guest lecturers are experts from all around the country with a variety of backgrounds: suppliers, regional/divisional engineers and researchers from universities, to name a few. Topics included for lecture or discussion are Superpave technology, chip seals, solvent-free extraction of hot mix asphalt, the reconstruction of the Kansas Turnpike between Topeka and Kansas City, and extending pavement life.

The cost of the program is $65 per person, which includes attendance to all 10 program sessions, registration packet, refreshments, luncheon and dinner.

Advanced registration is requested! Call Lorene at (913) 864-3284, 8 a.m. to 5 p.m., Monday through Friday; or mail in your registration form, which you will be receiving soon.

World's Oldest Paved Road in Egypt

To make it easier to transport heavy stones for pyramid building, the Egyptians laid what may have been the world's first paved road some 4,600 years ago. Geologists have identified a seven-and-a-half mile stretch of road covered with slabs of sandstone and limestone and even some logs of petrified wood. The pavement, they concluded, facilitated the movement of human drawn sleds loaded with basalt stone from a nearby quarry to a quay for shipment by barge to construction sites on the Nile River. The road, with an average width of six-and-a-half feet, ran across desert terrain 43 miles southwest of Cairo, Egypt.

Taken from ASCE NEWS, *June 1994*

Whitetopping

An alternative paving technique that could save you money

by Heather Edison Benson

Imagine yourself viewing a low-volume road with an old, deteriorating, bituminous surface. You know you can't afford to resurface, but patching and crack-sealing would be too little, too late. Something has to be done with the limited resources available. This is exactly the problem the Minnesota Department of Transportation faced with a deteriorated, low-volume rural highway. But instead of seeing it as a dilemma, they used it as an opportunity.

Highway 30, running east to west from U.S. Highway 169 at Amboy to State Highway 15, had declined drastically, and was in need of repair. They wanted to maximize the road performance, but at the same time they needed to minimize their costs. The innovative approach they took was whitetopping. That is, they placed an application of concrete over a bituminous surface. This had never been tried on a Minnesota State Highway until last August.

I spoke with Glenn Engstrom, the project engineer at MinDot, about the whitetopping and asked if they have been pleased with its results. The initial contact report of the surface mentioned that "most of the transverse joints had not cracked," and that, "the ride was generally good." Some patching was placed to repair initial defects in the concrete paving operation. But only nine random transverse cracks were found on 1.37 miles of the new surface. So far the concrete overlay has been a worthwhile investment, but Engstrom won't be certain of its performance until more tests are run sometime this fall.

Iowa, on the other hand, has been using whitetopping for a few years with good results.

Brian McWaters, IDOT, Aimes, recommends it for his counties' low-volume roads. They have had "good luck" with it, and he mentioned that it is "a lot cheaper for counties."

Last month IDOT had an open house on Iowa 21, Iowa county, north of I 80 on exit 205 for its newly whitetopped surface. The road is part of a five-year stress and structural study to test whitetopping performance capability. "The long-term performance of this surface is still unknown around here, but what we do know is good," said Brian McWaters.

For more information on whitetopping, we recommend contacting Brian McWaters, design guru for IDOT at (515) 239-1510. Also, we have a video on a whitetopping project done on I 70 in Sherman County, Kans. Use the order form on page 15 to obtain a loaner copy.