Calcium Chloride (CaCl₂)

Soil stabilization and dust control

Stabilization is a technique for upgrading the engineering properties of soils used in pavement construction. It involves the modification of soils or aggregates by incorporating materials that will increase load bearing capacity, firmness, and resistance to weathering or displacement. Soil stabilization is a tool that may be able to reduce your road building costs and conserve materials. Calcium chloride (CaCl₂) is one of many products now being used for soil stabilization. Other products include such things as asphalt, lime, fly ash, magnesium chloride, and kiln dust.

In order to illustrate the cost effectiveness of soil stabilization, FHWA has completed cost benefit studies on 24 separate cases. Generally speaking, soil stabilization leads to cost savings; however, the magnitude of these savings can vary significantly depending on the many factors that affect construction costs.

The rest of this article will deal strictly with CaCl₂ as a soil stabilization and dust control product.

Calcium Chloride in New Construction — During new construction, using CaCl₂ will help in the compaction process. It does this by properly maintaining moisture levels. The maintenance of optimum moisture during construction is the most important factor in obtaining maximum density and uniformity, both of which are necessary for good performance. Moisture limits for maximum

Asphalt Recycling: Know Your Options

You may be able to save up to 40-60% per job

With the cost of roadway materials increasing and road budgets decreasing, asphalt recycling is becoming more and more popular. However, if you or your town are interested in looking into asphalt recycling you should be forewarned: asphalt recycling can mean two different things to two different people. It is important when talking to a contractor or consultant that both of you are speaking the same language and that you know your options. One type of asphalt recycling procedure may cost 40% continued on p. 4

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- A Marked Increase In Traffic Accidents Can Be Reduced By Increasing Markings
- Has Your Computer Or Your Town's Computer Been Infected With A Virus?
- Strive For A Pothole-Free Environment
- Quick And Easy Patching
- Did You Know? (Grading gravel roads)
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- Preventing Sexual Harassment Suits

continued on p. 2
CaCl₂ and Cold In-Place Recycling — In situations where the road is not strong enough to carry the traffic, merely resurfacing the pavement is not satisfactory. Base failures will always reflect through a new overlay. One solution to this problem is to use cold in-place asphalt recycling (see the article in this news letter on asphalt recycling for more detail).

During the recycling process, liquid CaCl₂ can be added to assist in obtaining the required strength in the base. The recommended rate of application after the first pulverization is three-quarters of one gallon per square yard of pulverized material. The aggregate mass is then pulverized again to ensure proper asphalt, gravel, and CaCl₂ blending to the desired depth. A thorough blending of the CaCl₂ is essential. Then shaping and fine grading is followed by compaction. The compacted base should be sealed with one-quarter of a gallon of liquid CaCl₂ per square yard.

Using CaCl₂ with Unpaved Roads and Shoulders — To control dust and achieve stabilization within the top six inches of an unpaved surface, the following application procedures are recommended:

1. Add new material as required (determine if fines are needed for binding action or if aggregate is needed for stability — see the aggregate graduation table on this page for a guide);
2. Scraft the road surface to a depth of six inches;
3. Add a light application of calcium chloride to the scrafted surface; typically 0.4 gallons per square yard of 38 percent CaCl₂ liquid concentrate, 2.3 of 77-80 percent flake CaCl₂, or 1.95 of 90 percent CaCl₂;
4. Windrow or pulverize soil for a thorough mixing of the CaCl₂;
5. Blade, shape to a type “A” crown, and compact;
6. Top-dress the surface with CaCl₂ for dust control at a rate of approximately 0.2 gallons per square yard of 38 percent CaCl₂ liquid concentrate, 1.15 pounds per square yard of 77-80 percent flake CaCl₂, or 0.98 pounds per square yard of 90 percent pellet CaCl₂. This application level assures immediate dust control and initial stability of the top aggregate layer. Users can expect a highly compacted, smooth road and significantly reduced aggregate replacement and blading requirements. A 16-year maintenance study, for example, showed an average of five bladings per year required on unpaved roads maintained with CaCl₂, while 30 bladings per year were required on untreated roads maintained in a comparable condition. Average aggregate loss on CaCl₂ treated roads was recorded as 23.5 cubic yards per mile per year. This same study showed the average aggregate loss on untreated roads is estimated at one-half inch per mile per year, or 168 cubic yards (250 tons).

Whether you want to achieve dust control alone or the higher degree of surface stability, a second treatment with calcium chloride is generally recommended in late summer or early fall. Application rates for this second treatment are generally recommended at 0.27 gallons per square yard of 38 percent calcium chloride liquid concentrate, 1.55 pound per square yard of 77-80 percent flake calcium chloride, or 1.32 pound per square yard of 90 percent pellet calcium chloride.

Using CaCl₂ to Protect Against Frost Heaving — Studies completed at Purdue University have shown that CaCl₂, in a stabilized mixture, prevented frost heaving. As shown in the graph on page 5, small percentages of CaCl₂ in silt should provide adequate protection, and it can be assumed that even smaller amounts will suffice for other soils. Even an amount as low as one-half of one percent of CaCl₂ in silt will re-

### Table of Aggregate Graduation for Subbase Courses

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A Marked Increase In Traffic Accidents Can Be Reduced By Increasing Markings

Some thoughts on highway safety

Construction Work Zones

As our road system ages and major interstate and arterial roadways are upgraded, work zones multiply. The increased danger to motorists and highway workers is evident. Many work zones resemble mazes, requiring complex driving skills and instant reactions to unexpected situations.

As a result, it's not unusual to have a 300% increase in accidents when a highway is under construction. Despite safety improvements, traffic fatalities in the work zone increased 39% between 1982 and 1985. A path of travel that is clear to the driver 24 hours a day is mandatory to control congestion and prevent accidents. Specifically designed traffic control devices are needed that give clear, understandable warnings and guidance to the motorist making the work zone safer for driver and construction worker.

Night Driving

We are now doing more night driving than ever before. Highways that aren't safe at night, aren't safe at all. The result of highways being unsafe at night? Fatal -- 55 percent of all traffic fatalities occur at night, taking a devastating human and economic toll.

The Aging Population

Americans are growing older. The over-55 segment of our population is the fastest growing today. And the 60-year-old driver needs eight times more light at night than a 20 year old to see the same object and react to it. Highway devices, signs, and markings can compensate for the special needs of older drivers, who require more positive guidance to drive safely.

Reprinted from Directions, Volume 1, Number 2, 3M traffic control materials newsletter.
Has Your Computer Or Your Town’s Computer Been Infected With A Virus?

Like its biological cousin, a computer virus embeds itself within a host program and induces the host to replicate itself along with the virus of the computer in order to infect other disks.

Currently, the most common approach is for the virus program to be hidden within the operating system program (COMMAND.COM on PC machines). Once loaded into memory, the virus program instructs the operating system to copy itself onto any disk accessed by the computer (such as with DIR, TYPE, or COPY), if that disk already has the operating system file on it. Then, typically, after replicating itself a certain number of times, the virus proceeds to trash all the disks available to it at the time.

Actually, the virus mechanism is benign by itself. According to an article by Tom McBride and Nick Szabo in the March 1 edition of Info-Mat, “a ‘pure’ virus has survival as its only goal.” But any kind of “payload” can be attached to the virus, enabling it to print a message on screen, improve its survivability, avoid detection, or even destroy disk data. The payload can also be benign, but destructive or obstructive payloads seem to be the rule among the viruses reported recently.

Case history Although the concept of virus programs has appeared in the literature for several years (see “Computer Recreations” in Scientific American, March 1985, for an interesting discussion), only in the last year have many actual virus outbreaks been reported. Recent accounts cite infections within several user groups, in computer networks at IBM and Hewlett-Packard, and at the computing centers of several universities.

One of the most widely publicized occurrences was at Lehigh University, where late last fall a COMMAND.COM virus infected PC’s throughout the campus. The virus most likely escaped the campus and is now spreading itself around the world. Its characteristic is to copy itself four times, then trash every disk in the host system by erasing their boot records, FAT tables, and directories. Meanwhile, the virus’ four children will repeat the process somewhere else as soon as they are booted into another PC.

In a memo circulated at Lehigh University, Kenneth R. van Wyk of the Computing Center stated that “all Norton’s horses couldn’t put it back together again,” referring to the inability to recover data even with the Norton Utilities, one of the most powerful PC data repair programs available. He went on to say that both floppy and hard disks were affected, and concluded by saying “This is not a joke. A large percentage of our public site disks have been gonged by this virus in the last couple days.”

What is the degree of danger? Obviously, the potential for damage by viruses (and other sabotage programs) is very serious, although there are some who argue that the whole issue may be a hoax or urban legend, the computer-age equivalent of the Kentucky Fried Rat story. I doubt that anyone at Lehigh University would buy the hoax theory, but to the millions of users who have not come into contact with a virus, the whole thing certainly has a science-fiction ring to it. In fact, similar scenarios appeared in stories by several authors long before actual virus programs were created.

So far, viruses that use the operating system as a host are fairly easy to detect, and detection is the prime requirement for prevention. Szabo, who has made a hobby of designing (but not releasing) virus programs, feels that greater dangers may lie ahead. To put viruses into binary files other than the operating system is possible, he says, and would make detection much more difficult. The virus discovered last fall at Hebrew University in Jerusalem is reportedly of this type. Because of its ability to propagate itself to other disks, a virus

continued on p. 6
Asphalt recycling... continued from p. 1

less than another type; or, depending on the characteristics of the job, one procedure may not give you results as good as another procedure will.

For explanatory purposes, the Asphalt Recycling and Reclaiming Association (ARRA) has divided asphalt recycling into four types: hot-mix recycling, hot surface recycling, cold planing, and cold in-place recycling. Although some types of recycling are more common in our area than others, each of the ARRA categories will be defined below for information purposes. However, more time will be spent on cold in-place recycling since it is the category of most interest to the majority of New Hampshire towns.

Hot-Mix Recycling — This type of recycling involves a central plant blending and mixing operation to produce hot-mix paving mixtures. The mix may include any combination and amount, as necessary, of reclaimed asphalt pavement (RAP), reclaimed aggregate materials (RAM), new asphalt, new aggregate, or recycling agents. The recycling agents are used to restore aged asphalt to current standards.

There are two main types of hot-mix recycling processes: batch plant hot recycling and drum-mix hot recycling. The most common batch plant method accepted by the industry involves introducing the reclaimed asphalt pavement (RAP) from a separate cold feed bin into the pugmill, or weigh hopper, by a chute and belt conveyor. A batch plant can recycle RAP with new aggregate up to a 40:60 blend, although the practical limit is approximately 20:80. The industry-preferred drum-mix method is the center-entry method which introduces RAP into a drum downstream of a burner flame to mix it with superheated new aggregates. In this method, the maximum ratio of RAP to new aggregate is approximately 50:50; the practical ratio, however, is 30:70.

The performance of recycled asphalt concrete has been proven to equal that of conventional mixes. When quality control measures have been strictly adhered to, the uses and benefits of hot-mix recycling include the following:

1. Surface and base structural problems can be corrected;
2. Significant structural improvements can be obtained with little or no change in thickness (ex: untreated granular bases can be recycled into hot-mix asphalt concrete and then placed back in the same thickness);
3. Existing mix deficiencies, such as aggregate gradation problems, can be corrected;
4. Frost susceptibility may be reduced; and
5. It can be done repeatedly, using the same materials.

Hot Surface Recycling — The most common hot surface recycling method is the heater-scalifying method which involves the heating and scarification of an asphalt surface to a depth limited to 3/4 to one-inch. This type of recycling is least familiar to New Hampshire town road agents and public works directors primarily because of the cost. In order to provide a reasonable cost per square yard, the job would have to be large enough so that the contractor could cover the necessary move-in costs.

The main advantages of hot surface recycling is that it can reduce reflection cracking and application of the final riding surface (seal or overlay) may be separated from the recycling process for a long enough period allowing for thorough inspection of the heating, scarification, leveling, and compaction processes.

Cold Planing — This type of recycling (also known as cold milling) involves the automatically controlled removal of pavement to a desired depth with specially designed equipment, and restoration of the surface to a specified grade and slope, free of bumps, ruts and other imperfections. The resulting textured pavement can be used immediately as a driving surface, or it can be overlayed with a minimum of material. Cold planing has been done by town governments using motor graders with hardened steel blades for maintenance purposes. In recent years, cold milling machines have become more popular. They are more versatile, faster, and provide better results than would the motor grader approach.

Cold milling is an accepted recycling method for correcting ruts and washboarding, poor skid resistance, poor bonding potential, poor pavement profile, and diminished capacity of curbs and gutters. The main advantages of cold planning are as follows:

1. It can be done quickly with minimum interruption to the traffic flow;
2. When the process is complete, the restored pavement can be immediately opened to traffic;
3. A wide range of planning machines makes the process available to smaller cities and towns;
4. The process consumes substantially less energy than other methods of road rehabilitation; and
5. The reclaimed material can be saved for future use, as is, or taken to a hot-mix recycling plant.

On the other hand, the main disadvantage of cold planing is that the only type of distress that it will correct is a surface distress. It is sometimes very difficult, if not impossible, to determine if the distress is caused by surface, structural, or subgrade deficiencies.

Cold In-Place Recycling — This type of recycling is a road construction technique that re-uses existing pavement structure including, in some cases, the underlying untreated base material. All work takes place on the existing roadway and usually requires no transportation of material. Cold in-place recycling results in a stable road at a total expenditure of 40 to 50 percent less than that required by conventional construction methods.

Previously referred to as stabilization, cold in-place recycling is not a new approach to road rehabilitation; it has been around for close to 50 years. Equipment for this type of recycling has included rippers, scarifiers, pulverizers, and stabilizers. Emulsions, cutbacks, and other additives have been used in conjunction with these approaches.

In New Hampshire, the two most common cold in-place recycling methods use hammermill or a recycler (Bomag type recycling machine). These pulverizing/ mixing processes are usually the best choice for low volume roads where both asphalt and base rehabilitation are needed. The basic approach is to pulverize the pavement with the base and mix the two together. The mix is then graded and compacted.

Both the hammermill and the recycler (Bomag type) processes have been shown to be effective methods for cold in-place recycling. The two processes are distinctly different and their applicability is primarily determined by the existing subbase conditions. As a result, some construction companies are capable of using either method depending upon conditions; however, others specialize in one method only. The proponents of these recycling methods have been able to point to specific advantages of one method compared to the other as highlighted below:

hammermill

- This method has successfully recycled to a depth of 18 inches when required;
- This method will break up large cobbles found in the existing roadway into approximately 2-inch diameter stones vs. the recycler
method which can not adequately handle cobbles;
- The pavement/subbase mix appears to be a more uniform, homogenized blend than the salt and pepper mix produced by the recycler; and
- On thin asphalt pavements the hammermill will produce its usual maximum 2 inch diameter stone size while a recycler may have a tendency to break the asphalt surface into 4 inch slabs that are then driven below the surface producing a less uniform base.

recycler
- This method has successfully recycled to a depth of 12 inches with one pass and can go deeper with additional passes if required;
- The recycler method usually costs over 40% less than the hammermill method;
- This method is a pulverizing process, whereas the hammermill is a crushing process. With the right type of subbase (no cobbles), the recycler will result in a unified cold-mix type subbase blend for a lesser cost than the hammermill; and
- When thin pavements exist (1/2 to 3/4 inches) this method is not usually recommended; however, the recycler is designed for adding emulsified asphalt (or other appropriate soil stabilizers) directly through a spray bar during the recycling operation.

Calcium Chloride... continued from p. 2
duce the frost heave of that soil appreciably. In general, however, protection from frost heave in silt is afforded by two percent CaCl₂, in clay by one percent CaCl₂, and in graded mixes by one-half percent CaCl₂.

Migration and Leaching of CaCl₂ — One of the most commonly asked questions is whether the CaCl₂ will eventually leach its way out of the subbase. All indications at this time suggest that the migration of CaCl₂ from the road is minimal and lateral migration in silty clay soils under pavement is very slow. The fastest migration occurs up and down through the soil by rainfall or evaporation.

Cores taken from Route 108 in West Peru, ME (a road constructed in 1963) were tested by the Maine Department of Transportation. After 24 years there was still four-tenths of a pound of CaCl₂ per square yard remaining in the base. Furthermore, tests showed that there was a need for a one and one-half inch overlay on the road section with the asphalt stabilized base and no need for an overlay on the road section with the gravel and CaCl₂ mix.

The above information was extracted from this article from the following sources:
- Soil Stabilization and Cold In-Place Recycling. This publication is available by writing to: BOMAG (USA), P.O. Box 959, Springfield, OH 45501-0959.
- Bomaging A Road... A Guide to Soil Stabilization and Cold Mix Asphalt Recycling. This publication is available by writing to: BOMAG (USA), P.O. Box 959, Springfield, OH 45501-0959.
- Stabilization and Pavement Recycling. Prepared and approved by the Stabilization, Rehabilitation and Recycling Committee, American Road and Transportation Builders Association. A copy of this education and information guide is available through the Technology Transfer Center by calling 800-423-0609 or sending in the mailer attached to this newsletter.
- A Report on Long-Term Performance of Route 108, West Peru, Maine on Soil Cement Base, Asphalt Stabilized Base, and Crushed Gravel with Calcium Chloride Base. Presented to the U.S. Corps of Engineers Geotechnical Engineering Branch on October 22, 1987, Waltham, MA. James B. Picket. A copy of this education report is available through the Technology Transfer Center by calling 800-423-0609 or by sending in the mailer included in this newsletter.
Computer viruses... continued from p. 3

(hidden in a program file would be much more destructive than earlier vandal programs, which depend on people for distribution.)

A few simple precautions can usually protect against the known types of viruses. We can only hope that if more virulent types are developed, they will also be detectable and preventable, and that the threat of viruses will not put telecommunication and the public exchange of software in the deep freeze. It seems likely that as the complexity of the virus programs required to foil existing security precautions increases, the interest in creating such programs will wane. Of course, who knows what some maniac will come up with next?

How to protect yourself: Single-user systems are pretty safe from viruses, because of minimal disk sharing. Every disk exchange, new program coming in, and modem or network communication link is a potential avenue of entry for viruses and other vandal programs. An isolated machine with a bootable hard disk, that is never booted from a diskette, should be safe from operating system viruses. But the potential presence of viruses of other vandals in executable program files suggests the need for more care to be taken. New programs from public-domain or unknown sources should be tested in isolation at first; several runs may be necessary to guard against a Trojan horse.

Sound backup procedures and conscientious handling of disks are very important elements in protection against virus programs. Important data and programs should be stored and backed up on disks without the operating system, and write-protect tabs should be used whenever possible. (Covering the square notch in the edge of the diskette shell prevents data from being written onto the disk.) Keep "clean," write-protected copies of operating system and program disks in archive.

Detection of suspected viruses is essential. The Lehigh virus is easily detected: the COMMAND.COM file on infected disks carries a more recent write date than the original file, although the file size remains the same.

Another test is to boot up with the suspect disk (it would be wise to first back up the hard disk or use a diskette-only machine, since the program may be ready to do its dirty work), then ask for the directory (DIR d:) of another diskette, with a known "clean" operating system, with its write-protect notch covered. Getting a directory is normally a read-only operation, but if the virus is in control of the system it will try to write itself to the clean disk, generating a write-protect error. It seems reasonable to assume that similar tests will work with other operating systems.

Another reported virus can inhabit any executable (COM or EXE) file. Each time the program is executed the virus increases the size of the file (normally by 1808 bytes), which eventually causes the program to overflow disk space, memory space, or both. Also, shortly after infection, the virus will slow the host program by as much as a factor of five. This particular virus will erase any infected program that is executed on a Friday the 13th. To test for this virus, compare the program file size before and after running the program, or compare it to the size of the file on the original program disk (write protected). If file size has increased, the program, and others on the same disk, are most likely infected.

If a virus is found, copying the system file or executable files from a "clean" disk onto the infected disk will eradicate the virus (first make sure the computer is not infected by booting from a "clean" disk). Disks do occasionally lose data, but any time one of your disks is scrambled for no apparent reason, you should begin a careful check for viruses of other suspect programs. Above all, be aware that these things exist, and be on the lookout for them.

Several anti-virus programs have been developed that may offer attractive benefits to users whose systems are especially vulnerable to attack (network installations or semi-public sites), or who are in the vicinity of a known virus infection. For more information on some of these programs call the T² Center at 1-800-4230060.

If you are concerned and want to know more about viruses, I would suggest you read the Info-Mat news magazine, available on-line through the PC-TRANSPORT electronic bulletin board. Info-Mat has done a terrific job of covering the virus story as it developed over the past few months, and because it is a BBS magazine, I am certain that they will continue to provide in-depth information on the subject.

Once a Hard Disk is Infected

The following is a summary of what to do in the case of an infected hard disk, excerpted from the March 1988 issue of Computing News, from the University of Kansas Computing Center.

Immediately remove any floppy disks from your system and don't let anyone else use your system until it is restored to good health. If there is any chance you will be leaving your machine unattended where others have access to it, turn it off and leave a sign indicating that no one is to touch the machine until further notice. Then take the following steps:

1. Round up all of the floppy disks you have used that might possibly have been infected. At greatest risk are the disks that have COMMAND.COM on them. Depending upon the strain of virus, any disk containing an executable file is suspect. Set all these disks aside and identify them with labels, etc.

2. Reboot your machine from a floppy disk that you know to be good. In other words, you must avoid using the contaminated operating system on the hard disk by running a fresh copy from a floppy disk and then boot from the floppy drive. [Many machines will boot a diskette found in drive A: during either a cold (power-up) or warm (CTRL-ALT-DEL) boot.]

3. Delete COMMAND.COM from the hard disk and copy a fresh COMMAND.COM from a floppy disk you know to be good. If the virus is the kind that also infects any other executable file, you must check the size of every executable file on the disk against the size of the original version on the original floppy disk from which it came. This is tedious, but it is the only way to be sure. If you are absolutely certain that your last hard disk backup took place before the infection, you might want to reformat the hard disk and completely restore it.

4. Any infected floppy must also have their COMMAND.COM fields replaced. If necessary, replace the executable files as well.

5. To prevent the virus from spreading, you should also contact anyone who may have used your system since it became infected, and inform them that their disks may also be infected.

The above article was taken from PC-Trans, Vol. 2, No. 7. U of Kansas.

Page 6
What Happens When The Meeting Place Burns Down?

After a long wait and a lot of reconstruction, everyone is invited to the 2nd annual New Hampshire Road Agent Association Meeting set for July 22nd in Waterville Estates.

Last year the Road Agent Association was offered the use of facilities at Waterville Estates for its 1988 meeting. However, things got a bit hot when the place burned down. Reconstruction took somewhat longer than originally expected but the job has finally been completed. We thought it would be worth the wait and suspect that you will agree with us. Waterville Estates is an ideal location for what has been planned for this meeting.

What can you expect? Lots of outdoor demonstrations. The doors open up at 9:00 AM and the demos will continue past lunch. There will be plenty of time to comfortably see everything.

What will be demonstrated? As advertised, there will be "a mountain of demonstrations" including such things as grading, specialty welding, (see front page article in this newsletter), new patching materials and procedures (see article on p. 10 of this newsletter), easy crack sealing methods, uses of calcium chloride (see front page article in this newsletter), high tech ditching operations, affordable automated pavement management system, up-to-date information on state financing packages, and more.

How can you find out more? Call the Technology Transfer Center at 1-800-423-0060 and ask about the R. A. A. meeting.

An Educational Fund Has Been Established For Town Public Works Employees

$1,000.00 has been put aside to start a fund designed to assist public works employees with continuing their education.

It is hoped that the town public works employees who desire to continue their education will be able to take advantage of this new fund put together by the New Hampshire Road Agent Association. It is one of the interests of R. A. A. to promote the advancement of knowledge in the operation and maintenance of New Hampshire town roads. It is hoped that as the association grows it will be able to substantially increase the dollar amount in this fund and provide more stipends to its members.

Information concerning the application for these funds will be available at the R. A. A. meeting July 22nd in Waterville Estates.

Affordable Pavement Management

Come on July 22nd and see the new pavement management system designed for New Hampshire towns.

The R. S. M. S. (Road Surface Management System) is now available to New Hampshire towns. You can see it and try it out at the July 22nd R. A. A. meeting. Also, a one and one-half day hands-on training workshop has been scheduled for July 27th and 28th at the NH Technical Institute in Concord. For further information call the Technology Transfer Center at 1-800-423-0060.
A Very Big Pothole!

In Norwich, England this double-decker bus was stuck in the bus lane, literally, after a huge pothole swallowed the rear end of the vehicle. (AP Laser Photo, rwc60300 Press Association, 1988)
Strive For A Pothole-Free Environment

Repairs made the correct way will not only last longer, but will cost about 1/5th as much as the job that is hurried and done improperly.

While potholes cannot be eliminated entirely, a good repair program will help to considerably reduce the problem. Repairs made the correct way will not only last longer, but will cost approximately one-fifth as much as the job that is hurried and done improperly. Quite often, there is not enough time or resources available to do the repair the correct way; however, there always seems to be time to do it over and over and over. The throw and go-type of repair with several passes by the dump truck tires for compaction might last a month or two; however, when done correctly, the repair should last a year or more.

Permanent Pothole Repair Procedure Outline

There are 7 basic steps to pothole patching. Some steps can be adjusted to the conditions that exist, but for the most part, all steps must be closely followed to ensure a long-lasting patch.

Of course, before the patching is begun, one should have determined that this is the correct procedure. For example, in badly deteriorated sections, a complete overlay may be required. Of utmost concern should be the safety of the repair crew.

Surface & Base Cut

1. Marking: The area around the pothole must be marked with chalk or paint so that the worker doing the cutting can easily and quickly remove the failed material. Marking is done to include only portions of the pavement that will provide a good surface against which the patch is to bond; that is, these portions should have no cracks and appear solid compared to the area immediately adjacent to the pothole.

2. Cutting: The worker doing the cutting should avoid cutting more than is marked (excess cutting reduces cost effectiveness due to increased material use). The walls of the hole should be made vertical to provide a good surface for adhesion and “locking” the patch in during compaction. Cutting should continue to a depth where good pavement or base material exists.

If the pavement that is cut away is to be recycled, care should be taken to avoid including base and subbase material to prevent contamination of the mix. When the cutting is complete, the large chunks of pavement should be removed and stockpiled, if not used immediately, for future recycling.

3. Cleaning: This step includes removing any remaining debris from the hole. (Compressed air works well for this.) If the hole has been made to the base or subbase, these materials, if disturbed, must be compacted so that compaction by traffic will not occur after the patch is in place.

If the hole has water in it, the bonding of the patch will be poor. The hole must be dried as much as possible by using compressed air, a torch, rags, broom, etc. It should be stressed that all debris must be removed from the sides of the hole. Loose material will cause a poor bond, and lead to early failure of the patch.

4. Tack Coating: A tack coat should be used to provide a bond between old and new surfaces. Too much tack coat will result in an excess amount of asphalt, which will lead to rutting, and eventual failure of the patch. Hot mix, as well as recycled mix or cold mix, should always be tacked. The best method for tackling is to spray the tack in a thin coat. Brooming and pouring are generally not effective because excess tack material usually accumulates at the bottom of the hole and around the edges.

5. Placing: Holes deeper than 6 inches should be filled (and compacted) in more than one lift. Placing should be done with a shovel on one lift, working from one side of the patch to the other. To prevent segregation, the material should be laid, rather than thrown or raked, into the hole. The patch should be made so that after final compaction, it is slightly (about 1/8 inch) above the surrounding pavement to allow possible future compaction by traffic and eliminate birdbaits. No patching material should be left on the surrounding surface.

6. Compaction: It is crucial that the patch be compacted properly. Poor compaction will cause shrinkage of the patch, allowing intrusion of water around the edges and ultimately leading to failure.

The compaction method should match the size of repair. A one-square-foot patch does not require compaction with a 10-ton tandem steel-wheeled roller. Most road repairs can be made with small to medium-sized vibrating plate or roller compactors. Care should be taken by the operator to ensure that the compaction force is directed on the patch and not the surrounding pavement.

7. Edge Sealing: Edge sealing is done to keep water out of the joint between the pavement and patch. Any material can be used, so long as it does not cause excess asphalt to bleed around the patch. A layer of fine sand can be used to blot the seal.

With a good preventive maintenance program, the number of potholes can be drastically reduced. Under a preventive maintenance program, timely crack sealing and seal coating are the key ingredients. As soon as a pavement is built, preventive maintenance should start. Early detection and sealing of cracks is necessary. Also, periodic seal coats and/or rejuvenators (as appropriate) are important.

The majority of the information in the above article was taken from the Pothole Primer, U.S. Army Corps of Engineers, Cold Regions Research & Engineering Laboratory. The layout was adopted from The Wheel, Colorado State University. *
Quick and Easy Patching

Instant pothole patches have now demonstrated another desirable quality -- longevity.

For several years, a growing number of transportation and public works agencies have been trying new, modified asphalt patching materials. Robert Krull of the Federal Highway Administration’s Region 9 Technology Transfer Program has been monitoring the use and performance of three new patching products. The ease of use and excellent performance of these materials will soon revolutionize current pavement maintenance procedures, reports Krull.

The three brands with which Krull is familiar have some practical features in common:

- No cutting, shaping, cleaning, or preparation of the pothole is required.
- The hole can be wet or even full of water.
- No compaction equipment is necessary; wheel roll or traffic will suffice.
- Vehicles can travel over the patch immediately.
- No special equipment is required.

Two of the products are available packaged in bulk and have a shelf life of three or more years, even in bulk piles: UPM, a patching material from Sylvest Corporation; and HYDRO-PATCH, from Ophir Oil Co. Both products are pliable, a condition which increases in hot weather, and are primarily used for pothole patching and similar applications.

WESFRO from Wespro Asphalt Products is packaged in bucket or bag, and has a shelf life of about two years in closed containers. WESFRO sets up hard and is suitable for “skin” patches, pothole patches, and large areas. Compaction is desirable for thin or large area applications. WESFRO does not soften noticeably in hot weather.

Did You Know?

An unplanned road surface can revert to its original level of roughness 20 days after blading. Blading frequency can vary from twice a year to once every seven days, depending on traffic and local resources. The table below, taken from Unpaved Roads Maintenance Management published by the Purdue University School of Engineering, provides suggested grading frequency for various average daily traffic (ADT) ranges.

<table>
<thead>
<tr>
<th>Traffic (ADT)</th>
<th>Grading Days</th>
<th>Frequency Times/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>40-60</td>
<td>7-5</td>
</tr>
<tr>
<td>50-100</td>
<td>21-40</td>
<td>13-7</td>
</tr>
<tr>
<td>100-200</td>
<td>7-20</td>
<td>40-30</td>
</tr>
<tr>
<td>&gt;200</td>
<td>&lt;7</td>
<td>&gt;40</td>
</tr>
</tbody>
</table>

NOTE: Steep grades or locations with numerous driveways may require more frequent grading; also, with ADT >100 some form of dust control may be required and with ADT >200 stabilization or paving should be considered.

Technical Innovations

Eliminate squeegee from rubberized asphalt sealing operations

Most rubberized asphalt sealing operations involve three workers— one driving the truck, one operating the applicator wand, and one using a squeegee to remove the excess sealant. Bill Starks, a Highway Maintenance Supervisor for the Oregon Highway Division, has developed a device that eliminates the need for the squeegee. Not only does this device free up the squeegee operator for other duties, it decreases the amount of sealant lost to waste. The device puts the material where it is needed—in the crack, not on the surface of the road.

The device can be made from a 30 degree pipe elbow the same size as the pipe wand (usually 3/4”) and a conical, 4” washer. These washers are sometimes called compression washers or Belleville spring washers. The washer is welded to the elbow with the concave side facing the pavement (see the drawing below). The assembly is then threaded on the pipe wand. If the application’s too wide or too narrow, you can change the size of the washer to get the results you want. A smaller washer decreases and a larger washer increases the width of application.

These washers are somewhat hard to find. If they cannot be located in your area, contact the Technology Transfer Center at 800-423-0650 or send in the request form attached to this newsletter.

The information in this article was taken from the Oklahoma T2 newsletter, April, 1988.

Adapted from Technology Transfer Update, No. 29, Jan. 1988 (FHWA Region Nine Technology Transfer Program).

Editors’ Note: Products in this article are mentioned for the purpose of transmitting information; no endorsement is intended.
Preventing Sexual Harassment Suits

By Dave Goldberg in Northwest Technology Transfer Center Bulletin

Sexual harassment complaints, charges and suits have been filed against transportation-related employers. Some understanding of the nature of the problem and the employer’s liability, along with a determination of positive steps, can lessen or prevent the potential for sexual harassment in the workplace. Achieving this understanding is just as important as doing scheduled maintenance, or taking action to prevent equipment breakdown.

Guidelines on sexual harassment were adopted by the Equal Employment Opportunity Commission (EEOC) in 1980. These guidelines state that sexual harassment constitutes “discrimination because of sex” as defined under Section 703, Title VII of the Civil Rights Act of 1964, as amended. Courts have given great credence to these guidelines. They list two major types of harassment: “quid pro quo” and “hostile work environment.”

Quid pro quo (“this for that”) occurs when an implicit or explicit request for sexual favors is made in exchange for job benefits. The job benefits would be a term or condition of employment or the basis used for employment decisions; for example, hours of work, overtime, job location, etc.

A hostile work environment is created when verbal or physical conduct of a sexual nature unreasonably interferes with work performance or creates an “intimidating, hostile or offensive working environment.” It has been further defined by some states that the conduct must be unwelcome, must be sexually intended, and must affect the terms or conditions of employment. In addition, the EEOC and the courts recognize two other frequent situations: “injured party” and “non-employee harassment.”

Injured Party: Even if a supervisor and subordinate agree to exchange job benefits for sexual favors, a third employee who is “injured” as a result (loses job, promotion, assignment, etc.) may bring charges against the employer.

Non-Employee Harassment: An employer has an obligation to protect employees from sexual harassment by non-employees (passengers, contractors, etc.) to the extent possible and legal. The employer may be charged for not intervening.

Transportation agencies are particularly vulnerable to harassment charges. They tend to fit a profile defined by a study for the U.S. Department of Transportation in the 1970s. The study indicated the likelihood of harassment when women work in traditionally male jobs. Work groups in this profile: (1) are predominately male; (2) include the majority of women in low-paying/low-status jobs subordinate to men in positions of power/authority; (3) have poor communication between employees and supervisors; and (4) exhibit indication of pressure to flirt, make sexual jokes and “be one of the guys.”

Employers are held to strict liability in “quid pro quo” harassment cases since these involve supervisors harassing subordinates. Courts have held that employers should have known about such situations. Employers are liable in “hostile work environment” harassment if they knew of the situation, or if the harasser was a member of top management. In either case, the employer is required to act immediately and effectively to halt the harassment.

Many transportation agencies’ employees are worried that they may be unintentionally doing or saying something that may bring charges of sexual harassment. By observing some simple guidelines and discussing any questionable areas with personnel representatives, affirmative action staff, or supervisors, charges can be avoided. Examine your present behavior by using the following brief checklist:

Sexual Harassment Checklist

- Due to its sexual nature, would I object if someone said or did this to my wife/husband or daughter/son? yes no
- Do I base decisions on employment and benefits for my subordinates on their granting of denying of sexual favors? yes no
- Are sexual jokes, comments, pictures, or horseplay occurring on the job? yes no

For The Record

Straight From The Judge’s Bench

The U.S. Supreme Court last week turned away an appeal by Missouri officials who were found guilty of sex discrimination. The case involved the hiring of women as highway maintenance workers. The high court also refused to hear an appeal by women who said remedies ordered by lower courts against the Missouri Highway Department — a general order against discrimination instead of hiring quotas — were inadequate.


- Am I persistent in making sexual advances or comments even when someone says “no,” “draws the line,” or clearly signals my advances or comments are unwelcome? yes no
- Do I use terms like “baby,” “honey,” “sweetie” when referring to fellow workers of the opposite sex? yes no
- Do I say or do things just to get someone of the opposite sex “riled,” or “aggravated?” yes no

If the answer to any of the previous questions is “yes,” you have been given a warning sign. You need to examine and re-evaluate what you’re doing, and possibly seek advice from your supervisor or personnel office.

Remember that common sense, good taste, and good manners are just as important at work as they are at home. Rules for preventing sexual harassment can help to create a better work environment for all of us. Good judgment is just as important as the details of the law.
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