# HALIK LTD

## Operation Manual

## MATERIALS AND TECHNOLOGIES FOR ROAD MAINTENANCE AND REPAIR

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## Contents

# HALIK MATERIALS AND TECHNOLOGIES FOR ROAD MAINTENANCE AND REPAIR

## 1. Asphalt concrete – advantages and drawbacks

At present, flexible asphalt concrete pavements are most widely used all over the world. The service life of motor roads properly constructed of hot asphalt concrete may reach 20 and more years even under the conditions of intensive motor traffic.

However, the experience of maintaining and repairing motor roads shows that cracks and other defects appear on the surface of asphalt concrete pavement even during the first years of its service. Gradual ageing of the bituminous binder in asphalt concrete more and more intensifies the arising destructive processes, and all this results in losing the motor road performance properties and in the need for repair.

The results of numerous investigations being pursued in the field of using asphalt concrete pavements are indicative of the fact that the main destructive factors for asphalt concrete are the action of water, temperature fluctuations, and ultraviolet radiation.

Such destructive actions, combined with the action of traffic load and vehicle wheels, result in a considerable intensification of the pavement destruction processes.

Moreover, water penetration through the pavement causes destruction of the road subgrade, especially if the previously laid layers and the subgrade itself are improperly constructed or cracked.

A combination of the above described adverse factors shortens the service life and results in the necessity for early repairs of the pavement. The road pavement defects produce more and more problems year after year. They deteriorate the evenness of pavement, and correspondingly, reduce the speed and worsen the ride quality, cause an increase in vehicle operation costs, and above all, deteriorate the road safety.

The conventional methods of extending the service life of asphalt concrete are sometimes ineffective and often very expensive because they require the use of special heavy equipment. Modification of road bitumen with various polymers causes a sharp rise in the cost of asphalt concrete and fails to solve the whole problem. This approach only puts off the destruction of asphalt concrete for a short time because it does not allow prevention of new deformations and distresses for a long period of time.

## 2. Asphalt concrete sealing by conventional methods

The commonly used sealing materials are soft bitumen, bitumen emulsions or cutback oil applied on the pavement surface as a thin membrane ("Fog seal").

However, the use of the above materials for waterproofing has a number of essential drawbacks. The sections treated with such sealers show a lower skid resistance than the untreated sections for more than a year. So, the road safety deteriorates for this period of time. In addition, the road can be reopened for traffic in at least several hours after the treatment.

The frequently used system “Chip seal” consists in spraying bitumen emulsion on the existing pavement, covering it immediately with fine aggregate, and rolling. However, the bitumen emulsion has the above mentioned drawbacks, and the roads coated by the conventional chip seal method are suitable for light-traffic roads only.

Another conventional method is "Slurry seal" whose use is based on application of a specially prepared mixture of bitumen emulsion, crushed stone and water to the surface of asphalt concrete as a layer 8 to 12 mm thick, sometimes with subsequent rolling. Slurry seal can seal small cracks up to 3 mm wide (wider cracks should be sealed before the treatment).

Slurry seal also has a number of essential drawbacks such as low stability of the bitumen emulsion which can considerably affect the quality of treatment, and also a high cost of the necessary heavy equipment (a slurry truck). In addition, such a treatment remains effective for 3 to 5 years only, and after that the water resistance sharply drops, partial peeling and flaking occur. All this distorts the evenness of pavement and essentially affects the road safety. The conventional slurry seal is suitable for light-to-moderate traffic roads only.

A modification of the slurry seal method is microsurfacing where polymers are added to the essentially weak mixture. It should be noted that both slurry seal and microsurfacing are used to provide surface seal only to structurally sound pavements because these methods do not improve the structural strength of the pavement.

One of the conventional methods of major pavement repair is cold recycling. The deteriorated surface is removed by cold milling to a depth of several centimeters and taken to a central plant or stockpiled locally for reuse. The reclaimed material is mixed with bitumen emulsion at the central plant, placed on the road by an asphalt paving machine, and compacted. It can also be placed in a self-propelled mobile plant capable of mixing and placing cold recycling mixes in one continuous operation. This method, except for its high cost and the necessity for special heavy equipment, also has its drawbacks. If cracks in the old pavement are deeper than thickness of the layer being removed, they remain inside and continue to develop.

## 3. Combined action on asphalt concrete

The most effective technologies allowing a considerable extension of asphalt concrete service life are those combining surface waterproofing of the asphalt concrete with penetration of the applied material into the bulk of pavement for rejuvenation of its aged binder.

Such a combination allows, on one hand, waterproofing of the pavement surface, and on the other hand, it allows rejuvenation of the bitumen in asphalt concrete restoring its elastic properties and thereby improving the asphalt concrete deformability in any thermal cycles.

For this reason, HALIK undertook a research embracing the next stage of development – a change-over from bitumen emulsions and various other similar conventional materials to a better, cheaper and more long-lasting material which is free of their drawbacks and allows a combined action on asphalt concrete – the simultaneous waterproofing and rejuvenation. This advanced material is TL-2000.

## 4. Sealing rejuvenator TL-2000

The sealing rejuvenator TL-2000 developed, patented and being produced by HALIK (US Patents No. 5,284,887 of February 8, 1994, and No. 7,041,717 of May 9, 2006) provides an advantageous combination of the effects necessary for extension of asphalt concrete pavement service life.

TL-2000 not only can excellently seal the asphalt concrete but it can also revive and rejuvenate its binder – bitumen. Rejuvenation is achieved by penetration of the active gaseous component of TL-2000 into the bulk of road pavement, and this considerably reduces brittleness of the top asphalt concrete layer up to 60 mm thick and increases by far its elasticity.

At the same time, the ability of the gaseous component to penetrate asphalt concrete imparts unique sealing characteristics to TL-2000.

Firstly, the asphalt concrete surfaces coated with TL-2000 become resistant to water and various chemicals.

Secondly, the penetration allows TL-2000 to seal asphalt concrete and rejuvenate its binder.

Thirdly, TL-2000, with its powerful adhesive properties, can reliably bond any stone material.

Since TL-2000 chemically combines with bitumen and forms with it a whole in asphalt concrete, it contracts and expands to the same extent as the whole of asphalt concrete, unlike various surface treatment materials based on bitumen emulsions that create sealing coatings simply laying on the surface. They undergo quite different contraction and expansion as compared with those of asphalt concrete. Eventually, this results in cracking, peeling and flaking.

TL-2000 does not suffer from such drawbacks.

TL-2000 hardens upon contact with air. A thin film begins to form on the road surface as soon as after 5 to 10 minutes. At a temperature of 25°C, the coated road may be opened for traffic after 60 minutes. Some additives developed by HALIK make it possible to decrease or increase the TL-2000 hardening time on customer's request.

Some additional advantages of TL-2000 are listed below.

1. Excellent adhesion allows using TL-2000 as a primer (tack coat) between two layers of asphalt concrete and under the first its layer.
2. Certain information has been received that in the areas where salt is spread on the road surface to promote snow thawing in winter, the consumption of salt is reduced by 50% on the roads coated with TL-2000.
3. TL-2000 is effective for applying to road shoulders to prevent water infiltration.
4. TL-2000 is effective for applying to stabilized soil roads.
5. TL-2000 can be effectively used in construction and maintenance of bridges and viaducts (see the relevant section below).
6. Red and grey modifications of TL-2000 can be manufactured by adding the corresponding pigment (red or white, respectively). The red modification is suitable for road marking, especially for cyclists, and the grey one is primarily intended for tunnels, although it may be also used for coating concrete structures. According to European regulations, road coating in tunnels should not be black because the black surface

absorbs scarce light in the tunnel. The grey modification of TL-2000 containing a white pigment makes it possible to obtain a grey surface satisfying the European requirements. Both red and grey modification is produced by adding 20% by weight of the corresponding pigment instead of the same percentage of dolomite powder.

7. A thin membrane of TL-2000 can also be used to delete the needless road marking.
8. It is advisable to use TL-2000 as an anticorrosive coating for metal surfaces including the bottom surface of motor cars.
9. Due to the hydrophobic properties of TL-2000, the material applied to the pavement prevents water from forming a continuous film on its surface in wet weather (with rain or fog), and this considerably increases the skid resistance and allows a rise in traffic speed under these conditions.
10. It is possible to use TL-2000 for patching rusted-through holes in metal containers such as garbage tanks. For this purpose, a piece of strong fabric is soaked in TL-2000 and applied to the damaged place.
11. The material TL-2000 is environment-friendly due to the following features of its production and application:

- the production of TL-2000 is waste less: it leaves no waste requiring disposal;
- TL-2000 contains 70% of dolomite powder; so, this waste of asphalt production is used instead of being disposed of;
- when TL-2000 is used for pothole patching, the pothole filling mix contains 95% of waste (milled-off chips of old asphalt pavement) which otherwise would be subject to disposal;
- the use of cold waste (the milled-off chips) is also advantageous because both in Europe and in America, as a rule, this waste is heated to high temperatures to extract bitumen, which process is harmful for the environment;
- TL-2000 is used cold, and this decreases the use of hot-mix asphalt contaminating the environment.

12. Due to substituting cold-mix cold-laid materials based on TL-2000 for usual hot-mix asphalt, the producers of HALIK mixtures may get additional profit from reduction in the emission of $CO_2$ into the atmosphere ("Carbon Footprint"). The Carbon Footprint relates to the quota for $CO_2$ emission allotted to all enterprises. The quota is equivalent to a certain sum of money, so the unused part of the quota may be sold to another enterprise.
13. TL-2000 meets the requirements of EPA (US Environmental Protection Agency) regulations as regards the content of Volatile Organic Compounds (VOC). The VOC content of TL-2000 is considerably lower than the limit established by EPA.
14. A thin membrane of TL-2000 improves the protection of pavement surface from spilt fuel and oil. This is especially important for filling stations and runways where fuel and oil spilling is quite probable. TL-2000 may be applied without preliminary removal of fuel and oil from the pavement surface.
15. In countries of cold climate where the ambient temperature drops to or below –15ºC in winter, this results in increased pavement brittleness

and cracking, especially if heavy vehicles cause excessive stresses in the pavement. In this case, TL-2000 helps to solve the problem, comparatively decreasing the pavement brittleness, because it rejuvenates the road bitumen and thereby makes the pavement more elastic. In addition, the thin membrane of TL-2000 serves as a heat insulation shield protecting the pavement from negative ambient temperatures.

16. Since a thin membrane of TL-2000 closes pores and micro cracks in road pavement, this coating decreases the traffic noise.
17. A thin membrane of TL-2000 solves a problem of the slurry seal method widely used all over the world. The weak layer of slurry seal 8 to 12 mm thick is prone to rapid abrasion under the action of traffic, and the abrasion results in raveling and formation of deep ruts. The membrane of TL-2000 inhibits abrasion, retains the aggregate and thereby extends the service life of asphalt concrete, as ascertained by the tests carried out according to ASTM D 3901.
18. Bituminous roofing sheets require a primer for proper adhesion to the roof, and the adjacent edges of sheets are welded together with a hot tool frequently leaving holes in the roofing. The holes and deficient waterproofing properties of usual primers result in roof leakage. TL-2000, with its excellent adhesion and waterproofing properties, can be used as a primer to solve both problems and obtain leak-proof roofing, even with holes in the bituminous sheets.

It should also be noted that TL-2000 makes it possible to avoid the phenomenon known as pneumatic tire hydroplaning that can be very serious to all road vehicles in rainy weather. As the moving tire contacts and displaces the stationary layer of water on the road, the resulting change in momentum of the water creates hydrodynamic pressures that react on the road and tire surfaces. In compliance with the hydrodynamic theory, the resulting hydrodynamic pressure force tends to build up as the square of the vehicle speed. As the speed increases, water inertia effects tend to retard water escape in the tire-pavement contact region, and the water wedge formed tends to detach the tire from the pavement. At some critical speed, the hydrodynamic lift developed under the tire equals the partial weight of the vehicle acting on the tire, and any further increase in the speed forces the tire to lift completely off the road surface. Such a condition of the vehicle is very dangerous because it results in the loss of braking traction and the loss of directional stability, so that the brakes and the steering wheel become quite useless.

However, according to the studies carried out by NASA (US National Aeronautics and Space Administration, NASA Technical Note D-2056), the tires will not hydroplane below a certain minimum water depth on the pavement surface. Although this depth is difficult to determine because it depends on some other factors such as tire pressure and tire tread design, the NASA studies have shown that the water layer depth necessary for hydroplaning ranges roughly from 2.5 to 10 mm.

The material TL-2000 applied to the pavement surface decreases its MTD (macro texture depth) as determined according to ASTM E 965-96(06), and thereby allows water to drain off rapidly along the pavement crown slopes. The improved drainage prevents accumulation of water deep enough for

hydroplaning and thus considerably improves road safety and correspondingly allows a rise in traffic speed in wet weather.

In addition, the visibility and optical properties of the pavement are improved due to the reduced projection of water and a diffuse reflection, and the more effective drainage allows a better visibility of road marking.

In the case of construction of a new road, it is desired to apply TL-2000 to the pavement surface in 4 to 6 months after commissioning. TL-2000 may be applied later, even in about 2 years after construction, but such an initial treatment is very important for extending the road service life. In the course of further service, TL-2000 should be applied to the surface of asphalt concrete before deterioration of its quality due to ageing, i.e., in 8 to 10 years after the previous application. The sooner the ageing process is stopped, the easier and cheaper will be the pavement maintenance.

To achieve effectiveness of remedial actions, the performance of a bitumen-based pavement with respect to time should be properly understood. The ability of a pavement to carry load over time depends on the relative stiffness of the pavement layers. Cracking will occur when the stiffness of surface is too great in relation to that of the lower layer. The stiffness performance of a pavement is displayed in Fig. 1.

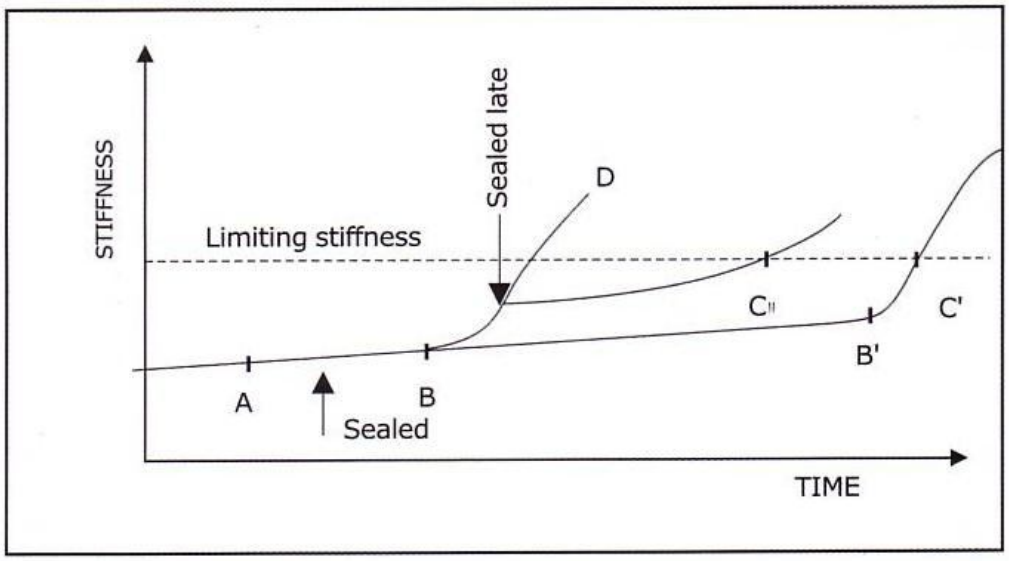



Figure 1 Seal effect on stiffness

The initial stiffness is represented at point A. Assuming a well compacted dense top layer, the change in stiffness is slow until weathering has been sufficient to let air circulate through the mix (point B). Once air (oxygen) circulates, the rate of stiffness increases rapidly with time (section BD). At certain stiffness of the surface, cracking is likely to occur.

For true long-term economy, the first treatment with TL-2000 should be performed before point B is reached. Such treatment should be based not only on field information but it should also be a function of time since construction or the previous application of TL-2000. A treatment which extends the time before deterioration will delay the hardening and cracking

process. The most economical approach would be application of TL-2000 before reaching point B. TL-2000 will prevent air and aqueous vapor from reaching the binder. The performance curve would then look like AB'C' in Fig. 1. TL-2000 applied after point B will delay the process of stiffening, and the limiting stiffness will be reached at point C''. The next TL-2000 coat should be placed before reaching point B'.

Application of TL-2000 every 8 to 10 years extends the service life of asphalt concrete pavement to a long period of time.

Owing to its excellent service on roads – and the quality of its service has been confirmed by many independent laboratories – TL-2000 radically changes the approach to the high-quality and inexpensive long-time maintenance of asphalt concrete.

TL-2000 can be used not only as a road coating material. A modification of TL-2000 can serve as a waterproofing coat for metal and concrete. Another, rubber-like modification (TL-R) is a very effective material for filling medium-size cracks in pavement repairs.

All modifications of TL-2000 can harden at temperatures down to –40°C. This feature allows waterproofing work to be done in the cold winter period.

For achieving optimum results in using TL-2000, it is advisable to check the exact viscosity of finished material before application. As measured with Brookfield viscometer (Spindle No. 6) at a speed of 100 RPM and at a temperature of 20ºC, the finished material viscosity should be about 3800 centipoises.

If transportation of the finished material takes relatively much time, special attention should be given to avoid undesirable dolomite settling.

TL-2000 is covered by patents in the USA, Canada, Japan, EEC and elsewhere. The roads coated with TL-2000 are in use in Europe, Asia, Africa and America.

## 5. The methods of road maintenance using TL-2000

### 5.1. Thin membrane (Fog seal)

This technique involves application of a thin layer of TL-2000 to the surface of an existing pavement in order to extend its service life. TL-2000 extends the road service life by 8 to 10 years by penetration into the pavement and rejuvenation of its bitumen. Thin membrane can be applied by the following methods:

1. Spreading the material poured on the road surface with hand rubber squeegees.
2. Mechanized spreading with a special trailed device which is a combination of rubber squeegees adjustable for height and cut vertically at appropriate intervals for passing occasional stones and road surface irregularities.
3. Spraying the material onto the road surface with a special mounted device having appropriate nozzles.

If necessary, HALIK may provide sketch drawings of the above devices.

The best results are obtained on roads with rather rough surface such as shown in the picture below.

A special modification of TL-2000 is also very effective if applied to the surface of soil, sand or crushed stone shoulders because TL-2000 provides the lateral protection of road from water.

The thin membrane is also effective in sealing cracks up to 3 mm in width.

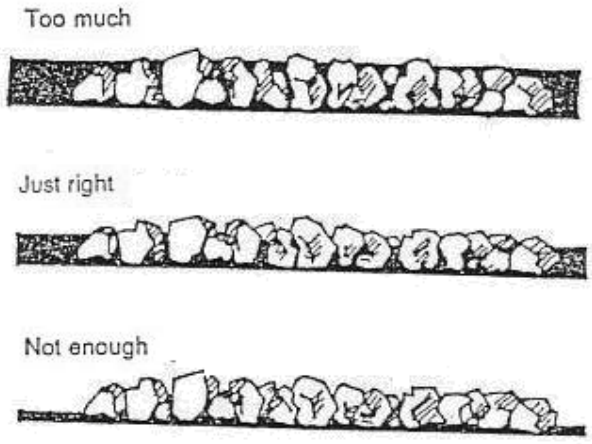
Application of a thin membrane of TL-2000 to the stabilized soil road surface gives it additional waterproofing and the appearance of a newly built asphalt road.

The material consumption is 0.7 to 1.2 kg per sq. meter.

## 5.2. Chip seal

Road coating with chip seal consists in that the sprayed asphalt is immediately covered with aggregate and rolled. The treatment is economical, easy to apply and long-lasting. It provides skid resistance and a waterproof cover over the underlying structure that can even recondition an old and weathered pavement surface.

A diagram of the coating showing the proper quantity of binding material is shown below.

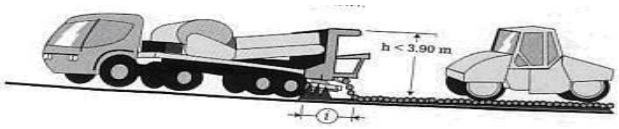



By replacing the commonly used binder by TL-2000, one can obtain stronger bonding to the aggregates, thus providing better skid resistance and waterproofing for longer periods. Having special adhesive properties, TL-2000 reliably keys stone material to the road forming a strong connection for years. Such treatment can reliably correct some defects of the road surface, at the same time rejuvenating the asphalt concrete bitumen and restoring its lost elastic properties.

The thickness of chip seal layer is about the same as the nominal maximum size of aggregate particles: for general treatment, the thickness of the layer and the nominal maximum aggregate size should be about 1 to 2 mm.

The application rate per square meter is 1 to 1.2 kg TL-2000 and 200 to 300 grams of the small-size aggregate.

It should be noted that the use of special HALIK hardener TL together with TL-2000 enables using coarser aggregate thereby increasing the thickness of chip seal.




### 5.3. Crack sealing

TL-2000 and its cold rubber-like modification TL-R are very effective for sealing various cracks.

If the cracks are narrow (at the most 5 mm wide), seal them by coating the whole surface with TL-2000 as described under "Fog seal" above.

If the crack width is from 5 mm to 4 cm, two different methods may be used to seal the cracks. The first one is intended for asphalt concrete pavements and based on using the rubber-like modification TL-R, and in the second one intended for cement concrete pavements the cracks are sealed with a compound consisting by ⅓ of TL-2000 and by ⅔ of sand thoroughly mixed together.

If the cracks are wider than 4 cm and pass through the whole thickness of the pavement, patch them as described under "Pothole patching" below.

## 5.4. Pothole patching

This technique involves replacing the full depth of the asphalt concrete layer and may include replacement of the base and sub grade layers under the pothole.

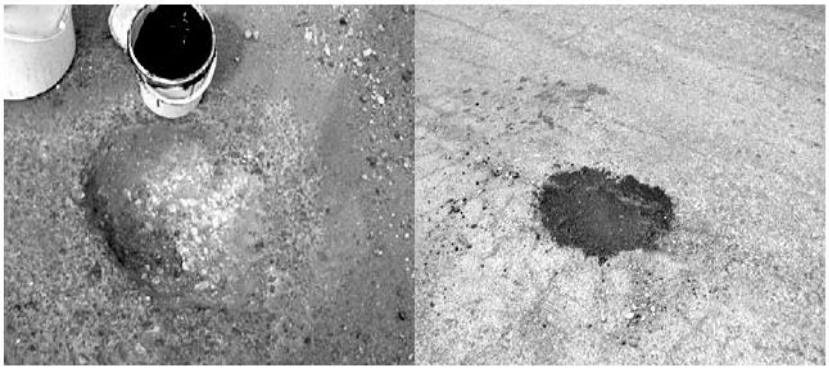
Usually the pavement is repaired by making a full-depth patch consisting of hot-mix asphalt (HMA) which operation is rather expensive because it requires the use of special heavy equipment. The commercially available cold-laid mix is also used for this purpose; however, such patches, without reliable waterproofing and adhesion at the bottom and on the sides, come off the surface in 3 to 5 months, i.e., do not last even one cold winter.

Halik has developed two highly effective cold-laid asphalt mixes intended for pothole patching and surface treatment of pavement. They are as follows:

1. Milled-off asphalt concrete chips or recycled old asphalt mixed with 5% to 10% of TL-2000 depending on the type of filler. The material requires no special preparation of potholes: no cleaning the pavement surface, no debris removal, no cutting to form vertical sides. The only requirement is a solid bottom of the hollow. The pothole is simply filled with the material flush with the surrounding pavement. This is done even at a low temperature, even if the pothole is full of water, and even if there is snow in it in winter. Then the patch is slightly compacted with a hand tamper, and the road may be opened for traffic immediately. Further strengthening and compaction of the patch occurs under the action of traffic. If it is desirable to exclude mixing, a pothole may be filled with milled-off asphalt concrete chips that should be thoroughly compacted flush with the surrounding pavement surface and coated with a thin membrane of TL-2000 as described under "Fog seal" above.
2. Special cold HALIK adhesive mixed in a certain ratio with aggregate. So, cold asphalt modified with polymer is obtained. This material has the same advantages as the first one: requires no pothole preparation and simply laid into the pothole in any weather, in summer or in winter, and the road may be opened for traffic immediately after the completion of work. The technique is the same as described above for the mixed material. Moreover, this material may be stored for a long time, indoors or outdoors in any weather, without any caking or cladding.

Our advantage over HMA is also that the HMA cools down very soon and occupies a constant volume in the potholes practically unchangeable after filling, while the pothole always have some elasticity because of the nature of flexible asphalt pavement and will always move a little. On the contrary, the HALIK material remains a bit elastic and retains the ability to deform in the pothole, and thus it sticks better to the pothole walls. Because of this feature, the pothole patch will remain intact for a longer period of time. A convincing experiment may be made by cutting test cores from the pothole area and measuring the remaining elasticity over time.

The same materials and methods are also suitable for elimination of rutting.



## 6. Evaluation of pavement condition

In order to ensure proper road maintenance, it is important to have an objective quantitative measure of pavement condition.

In the USA and some other countries, Pavement Condition Index (PCI) is used for this purpose (see, e.g., ASTM D 5340-04, ASTM D 6433-03 and the relevant literature, such as: M.Y.Shahin, "Pavement management for airports, roads, and parking lots", Springer, New York, 1994)). The PCI is determined as follows.

The entire pavement whose condition is to be evaluated is divided into sections of uniform construction, maintenance, usage history, and condition. The sections are subdivided into sample units to be visually surveyed. The sample units should be uniformly located over the section.

In inspection of each sample unit, a special form is filled in to indicate all types of pavement distresses found on it, their area, and the severity of each distress (low, medium, or high). The areas of all distresses of the same type and severity are added up, and the share of area of each distress (with its severity) in the whole area of the sample unit is determined. Then special curves are used to determine the deduct value for each distress type and severity, and the total maximum deduct value for the sample unit is determined by a special method. The obtained total deduct value is subtracted from 100 to determine the PCI for the sample unit and thereby to evaluate its condition.

After that, by adding up the products of PCI by the relevant sample unit areas and dividing the sum by the total area of the section, the total PCI for the section is obtained.

Thus, the PCI is a numerical index ranging from 0 for a failed pavement to 100 for a pavement in perfect condition. The values of PCI correspond to the following qualitative ratings:

| PCI | Rating |
|---|---|
| 100 to 85 | Excellent |
| 85 to 70 | Very good |
| 70 to 55 | Good |
| 55 to 40 | Fair |
| 40 to 25 | Poor |
| 25 to 10 | Very poor |
| 10 to 0 | Failed |

A critical PCI is defined as the PCI value at which the rate of PCI loss increases with time, or the cost of applying preventive maintenance increases significantly. This means that it is more economical to maintain pavements above rather than below the critical PCI. Fig. 2 is a schematic diagram of an example deterioration curve showing the usual range of the critical PCI, which is 70 to 55 (good condition of the pavement).

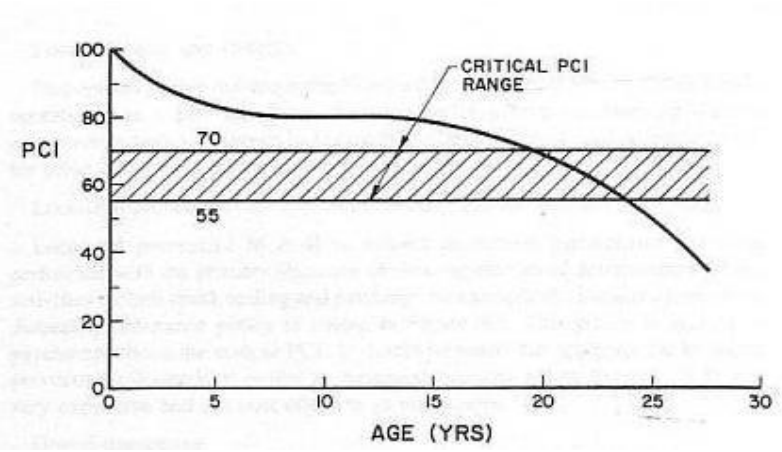



Fig. 2. Schematic diagram of a road deterioration curve.

Of course, the period of 20 years before the necessity for maintenance and repair shown in Fig. 2 only applies to ideal road base, perfect design and construction of the road. In practice, owing to imperfect road base and inadequate design and/or construction, this period is usually about half as long.

## 7. Correction of pavement distresses by using HALIK materials

According to ASTM D 5340-04 and ASTM D 6433-03, there are about 15 different types of distresses that may occur in an asphalt concrete pavement. They all can practically be corrected by using HALIK materials and technologies. It is very important to emphasize here that the conventional methods of correcting the distresses almost always require the use of hot asphalt mix and special heavy equipment which is very expensive to buy or hire. By contrast, the HALIK methods of distress correction do not require hot asphalt mix or any special heavy equipment. The correction operations can be performed manually with even better results.

Some of the above distresses are considered below.

### 7.1. Alligator cracks

Alligator or fatigue cracks are a series of load-related interconnecting cracks caused by fatigue failure of the AC surface under repeated traffic loading.

Correct the distress as described under "Crack sealing" above.

With medium- or high-severity alligator cracking, the procedure described above under "Pothole patching" may prove to be necessary.

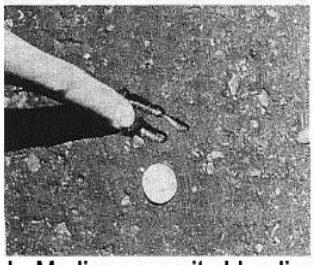
.a. Low-Severity alligator cracking .b. Medium-severity alligator cracking .c. High-severity alligator cracking

### 7.2. Bleeding

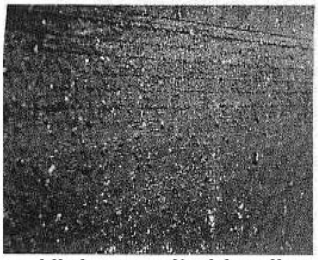
Bleeding is a film of bituminous material on the pavement surface that usually becomes quite sticky. Bleeding is caused by excessive binder in the mix. It occurs when the binder fills the voids of the mix during hot weather and then expands onto the pavement surface.

Bleeding is corrected by the chip seal method as described above under "Chip seal".

.a. Low-severity bleeding



.b. Medium-severity bleeding

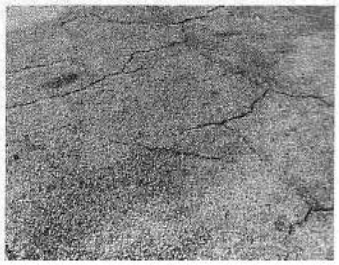


.c. High-severity bleeding

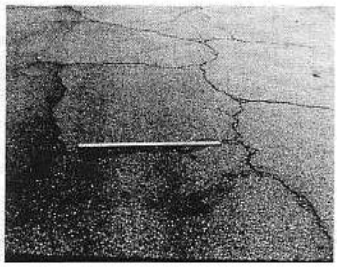
### 7.3. Block cracks

Block cracks are interconnected cracks that divide the pavement into approximately rectangular pieces from 0.3 by 0.3 m to 3 by 3 m in size. They are not load-associated and caused mainly by shrinkage of the asphalt concrete during daily temperature cycling.

Correct the distress as described above under "Crack sealing".



Low Severity block cracking



Medium Severity block cracking

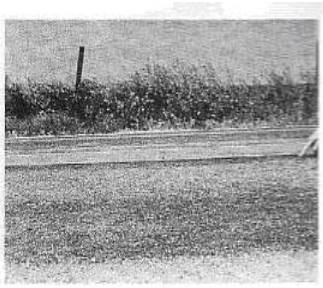
High Severity block cracking

### 7.4. Corrugation

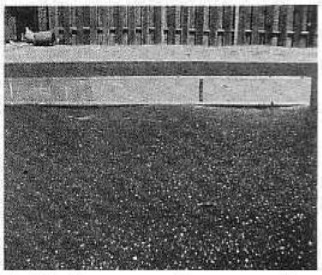
Corrugation is a series of closely spaced ridges and valleys occurring at fairly regular intervals (usually less than 1.5 m) along the pavement perpendicular to the traffic direction. This type of distress is usually caused by traffic action combined with an unstable pavement surface or base.

If corrugation only slightly affects ride quality, no correction is necessary.

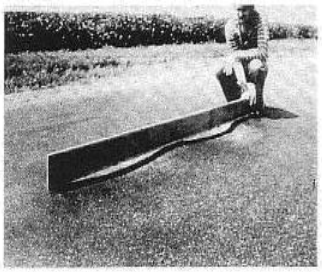
If ride quality is severely affected, remove the ridges and patch the areas as described under "Pothole patching".



.a. Low-severity corrugation



.b. Medium-severity corrugation



.c. High-severity corrugation

### 7.5. Edge cracks

Edge cracks caused mainly by poor quality of the road base or subgrade are parallel to and usually located within 0.3 to 0.6 m of the outer edge of the pavement.

Correct the distress as described under "Crack sealing" above.

With medium- or high-severity edge cracking, the procedure described above under "Pothole patching" may prove to be necessary.

Fill and regrade the shoulders to match the lane height and coat them with TL-2000 to stabilize.

.a. Low-severity edge cracking

.b. Medium-severity edge cracking

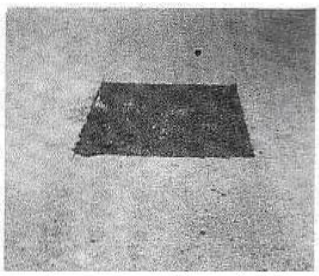
.c. High-severity edge cracking

### 7.6. Patches

A patch is an area of pavement that has been replaced with new material to repair the existing pavement.

If a patch is in good condition and does not deteriorate ride quality, coat it with a thin membrane of TL-2000 together with the surrounding pavement.

If a patch is badly deteriorated, replace it as described under "Pothole patching".



.a. Low-severity patching

.b. Medium-severity patching

.c. High-severity patching

### 7.7. Polished aggregate

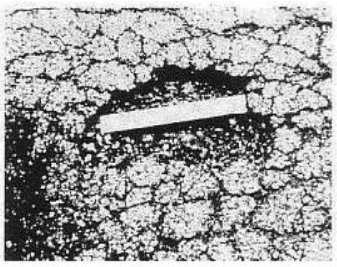
This distress caused by repeated traffic applications manifests itself by the aggregate in the surface smooth to the touch and by the reduced road grip of a tire.

Correct the distress by fine milling to a depth of 4 mm in order to increase the friction factor. To seal all micro cracks caused by fine milling and protect the pavement, coat the surface with a 1-mm thick membrane of TL-2000.

**Polished aggregate**

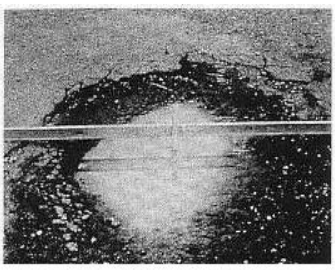
### 7.8. Potholes

Potholes are bowl-shaped depressions in the pavement surface.
The method of correction is described above under "Pothole patching".



.a. Low-severity pothole

.b. Medium-severity pothole

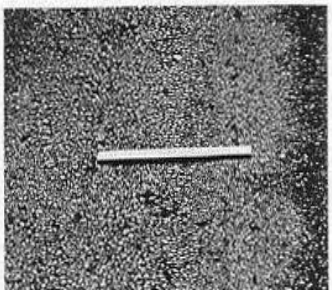


.c. High-severity pothole

### 7.9. Weathering and raveling

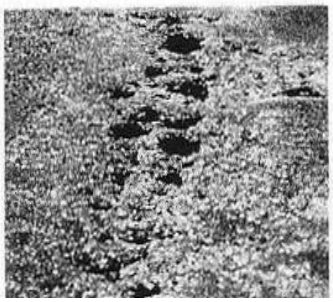
Weathering and raveling are the wearing away of the pavement surface due to a loss of asphalt binder and dislodged aggregate particles.

Follow the procedure described under "Chip seal". If necessary, coarser aggregates may be added.



**.a. Low severity weathering and raveling**

**.b. Medium severity weathering and raveling**



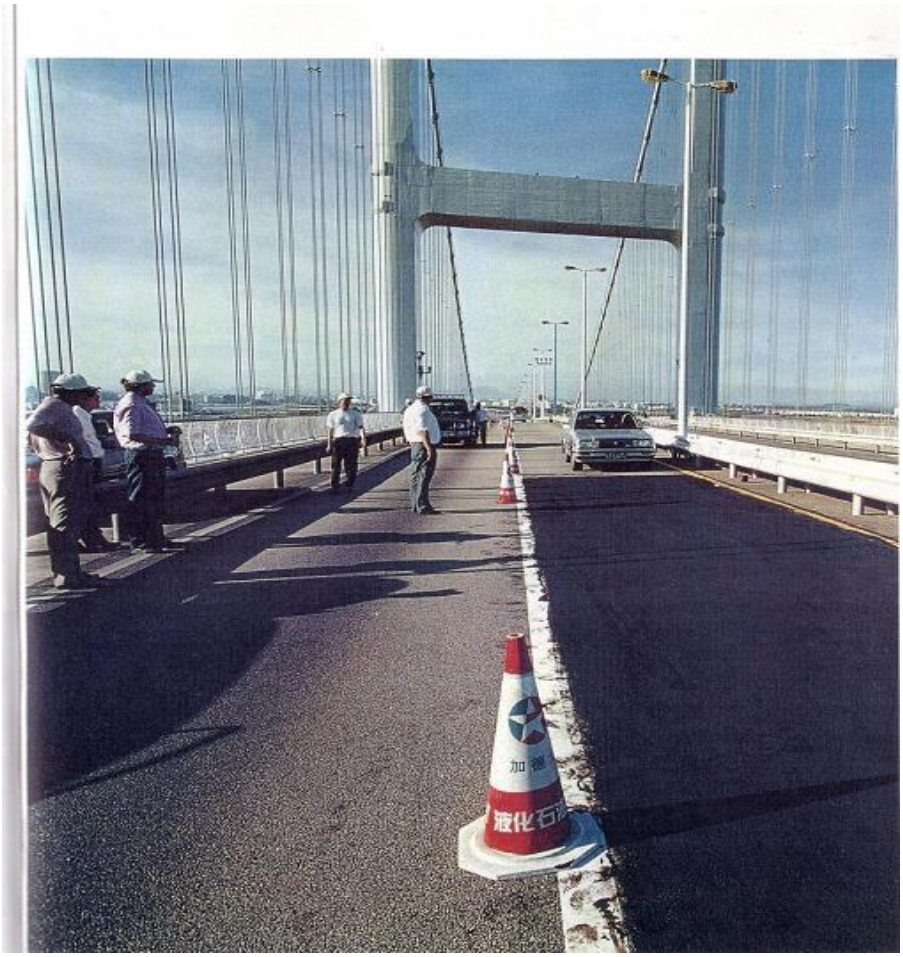
**.c. High severity weathering and raveling**

## 8. Bridge and viaduct construction and maintenance using TL-2000

Bridges and viaducts present very serious problems because acid pluvial water penetrates the reinforced concrete structure and causes intensive rusting. The conventional solution in this case is removing all the asphalt concrete, coating the structure with a fresh waterproofing course and laying a new asphalt concrete pavement. All this work is very expensive and closes the bridge or viaduct for traffic for a long time.

The use of TL-2000 is especially advantageous on bridges and viaducts because excellent waterproofing properties of the material prevent water penetration to the structure reinforcement. The optimum results are achieved by using the thin-membrane method of preventive or corrective maintenance.

In addition, application of a thin layer of TL-2000 between the reinforced concrete structure and the pavement (and also between the pavement layers) provides excellent waterproofing and protection of concrete reinforcement from penetration of moisture and chemicals (acids, alkalis, etc.) carried by it, and consequently from corrosion. In this case, while the hot asphalt mix is being laid on the thin membrane of TL-2000, its gaseous component penetrates the bulk of asphalt and ensures hydrophobity of the whole pavement layer.



*It should be noted that this Manual only gives general information related to pavement repair and maintenance by using HALIK products. HALIK understands that every particular problem requires its specific solution, especially if it involves high-severity damages to the pavement. For this reason, it is recommended to take final decisions in complex cases in consultation with HALIK specialists or local authorized representatives of the company.*