CHAPTER TWELVE

Chipseal Failures and Repairs

Chapter 12 Chipseal Failures and Repairs

Previous page: Chipsealing in progress on State Highway 73, west of Arthur's Pass. One of the reasons for the chipseal was to repair the lightly flushed existing surface seen on the left of the road. This photo was taken in high summer, as indicated by the flowering rata trees. It is also the best time for sealing.

Photo courtesy of Les McKenzie, Opus

Chapter 12 Chipseal Failures and Repairs

12.1 Background

The intent of this chapter is to describe those seal failures that occur soon after the construction of new reseals, and to identify their causes. As well it includes suggestions for their repairs that will give satisfactory results and, where appropriate, will enable the design life of a particular seal coat type to be achieved. It does not include seal performance and seal life which are covered in Chapter 4, or pre-reseal repairs which are covered in Chapter 7.

Even though the design and construction principles outlined in the preceding chapters may have been followed, post-sealing failures do occur and faults do develop. The type or cause of a failure must be identified, and an appropriately timed treatment decided on and applied. Otherwise a failed seal can develop which will require significant and expensive repairs. This chapter does not deal with all the symptoms that appear during the life of a chipseal as it deteriorates. For example, this discussion does not include cracking or layer instability (covered in Chapters 6 and 7).

This chapter only deals with failures that can be corrected through a treatment that is designed to correct the deficiency, instead of renewing the seal. Apart from unscheduled reseals required at short notice (Section 12.8), reseals are not covered in this chapter.

12.2 Texture Loss

Texture loss and cracking, as discussed in Chapter 4, are the main causes of seal failure. Seal failures by texture loss can include:

- premature binder rise;
- flushing;
- bleeding;
- chip loss;
- chip rollover; and
- pavement structural failures.

If these are treated appropriately and promptly, the surface often can continue to function as intended.

Some of the factors that contribute to loss of texture include:

- chip re-orientation so that the height of the chip decreases;
- overspraying, which results in too much bitumen;

- chip embedment as chip is pushed down into the substrate;
- binder rise around the chip;
- chip crushing and breakdown during construction, thus reducing effective chip ALD (over-chipping can also cause this) (see Figure 11-3);
- long-term consolidation (not just post-construction) of the layer caused by the tyre–seal interaction stresses;
- further chip embedment caused by the action of vehicle tyres in periods of high temperature.

12.2.1 Chip Re-orientation

If, after the seal has been designed and constructed correctly, higher than expected traffic volumes occur, flushing could be the expected failure mechanism at the end of its design life. This means the seal will flush in the wheelpaths before the binder has hardened and leads to texture loss by chip embedment, wearing of the chip, etc. (see discussion in Section 4.3).

12.2.2 High Binder Application

Premature flushing occurs when the binder application is too high for the traffic volume. This can be caused by design or construction error. It can also occur where the existing surface varies in texture or hardness.

To avoid flushing in wheelpaths the seal design often has to be a compromise between an application rate that suits the wheelpaths, with some possible chip loss elsewhere (between and outside the wheelpaths), and an application rate that suits most of the road. There is some discussion on this topic in Section 9.4.5. Controlled trafficking during the first few days can be used to compact chip on areas outside wheelpaths, discussed briefly in Sections 9.10.3.3 and 11.4.1. Early chip loss can be repaired relatively easily but a flushed surface is more difficult and expensive to repair. Chapter 9 discusses the design philosophy for such situations.

12.2.3 Chip Embedment

Soft substrate and chip embedment are regular causes of flushing and so are taken into account in seal design (Section 9.4.1).

If chip embedment is greater than normal, it may be caused by presence of softer substrates associated with:

- first coat seals;
- fresh asphaltic concrete;
- new grader-laid asphalt, or OGEMs (open graded emulsion mix);
- repairs to poorly constructed and weak pavements, or poorly constructed repairs;
- a pavement weakened by water;
- a pavement flushed with a binder-rich surface;
- a soft pavement caused by build-up of successive seals with an excess of bitumen >12% by weight.

An outline of the effects of soft substrate is given in Section 4.7.4.1.

12.2.4 Binder Rise

Binder rise is a natural action which occurs over the life of a chipseal and can cause flushing and bleeding (Figure 12-1). Some researchers believe that the chips are pushed into the binder rather than the binder rises over the chips. In fact both can happen.

Figure 12-1 Small holes are evidence of binder rise through the action of vapour venting (volcanoes) (see also Figure 4-20). Photo courtesy of Les McKenzie, Opus

Read Section 4.7.4 and its subsections which describe the principal causes of binder rise and how it leads to flushing.

12.2.5 Flushing

Flushing occurs as a result of high binder rise and reduces the macrotexture of the road surface until it is so low that it meets one or more of the definitions of flushing given in Section 3.11.6.

If flushing is left untreated:

- safety issues associated with low macrotexture can arise, e.g. extended braking distances in the wet at speed (as discussed in Section 4.9.3.1);
- when the flushed binder has low viscosity in hot weather, bleeding and tracking (Figure 12-2) with associated safety issues can occur (as discussed in Section 12.2.6 below);
- further binder rise can occur, exacerbating the above problems and requiring costly repairs.

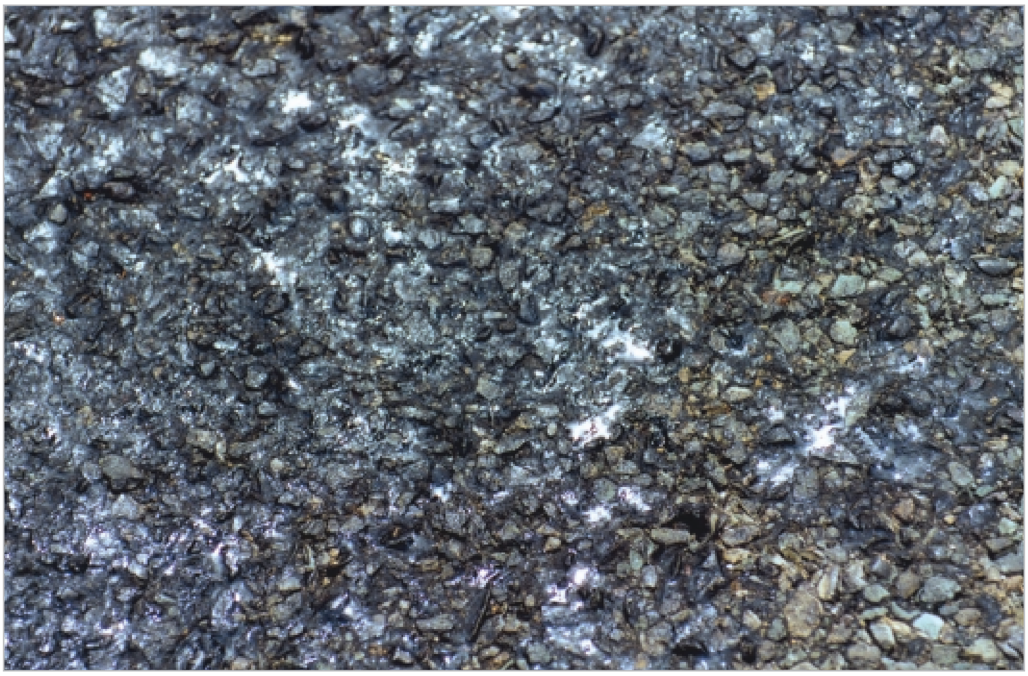

Figure 12-2 Bleeding in progress. Photo courtesy of Mark Owen, Transit NZ

12.2.6 Bleeding

As mentioned above, and discussed in Section 3.11.7, binder rise can result in bleeding (Figure 12-2) which occurs when the surface tension of the binder is broken and tracking can occur (Figure 12-3).

The pavement need not be flushed in order for it to bleed as truck tyres indent up to 1.5 mm into a seal as shown in Figure 9-12, and discussed in Section 9.9.3.3. This mechanism helps to explain why a seal with a good texture can suddenly blacken because binder has been picked up from a surface of seemingly high texture.

It is important to note that a flushed surface may not bleed if the binder is hard enough, the temperature is cold enough, or the binder is contaminated with fines from the road surface.

Figure 12-3 A surface showing both bleeding and tracking on a hot summer day, possibly caused by an old repair patch. This has caused the current chipseal to flush and bleed.

Photo courtesy of Les McKenzie, Opus

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If bleeding is not treated promptly,

- tracking occurs with associated safety issues (e.g. low skid resistance because the microtexture is masked);
- extensive damage to the seal may occur (e.g. heavy or slow moving vehicles have been observed pulling out tyre-width sections of seal, sometimes down to basecourse depth);
- the blackened surface absorbs heat, and will become hotter than the original seal by 10°C or more. This hotter surface can exacerbate the problem leading to widespread bleeding along the pavement.

12.3 Chip Loss

Repairs are essential for a new seal that shows areas of chip loss, to retain seal integrity and to prevent the areas from expanding into a major surfacing problem.

Surplus chip from chip loss by stripping becomes a safety issue and can result in loss-of-control crashes, broken windscreens, injury to the general public from flying chip, and general damage to other road users.

12.3.1 Causes of Chip Loss

Chip loss can occur for a number of reasons which are listed here.

- Low binder application rates.
- Traffic stress, e.g. from high speed, turning, high volumes, or increased heavy traffic volume during the seal's life.
- Cold weather affecting binder characteristics, e.g. sealing in late summer, cold overnight temperatures.
- Wet weather affecting binder characteristics during and after sealing.
- Lack of diluent or adhesion agent.
- Sealing over poorly constructed pre-reseal repairs.
- Cold binder.
- Fretting of the upper chip layer of a two coat seal.
- Dirty chip (Figure 12-4).
- Binder oxidation.
- Stop-start traffic, particularly on up or downhill sections of roads, e.g. rubbish trucks on urban streets.
- Heavy braking and acceleration.
- Scuffing, e.g. using power steering in parking lanes.

Figure 12-4 Chip loss caused by dirty chip in the seal. Photo courtesy of Les McKenzie, Opus

12.3.2 Types of Chip Loss

The three main types of chip loss are:

- Stripping, which occurs generally along wheelpaths, in long strips.
- Attrition, in which the chips are worn away by friction.
- Scabbing, which is chip loss from patches of chipseal.

Some chip loss occurs soon after construction and is related to construction deficiencies, e.g. dirty chip, lack of adhesion agent, excess traffic speeds during or soon after construction. Further chip loss can occur during normal service or if rain falls immediately after sealing.

12.3.3 Extent of Chip Loss

Chip loss or stripping can range from light chip loss between wheelpaths and on the centreline to extensive loss across both traffic lanes.

Once chip loss starts it can increase very rapidly because of lack of support from the surrounding chips. Once the shoulder-to-shoulder lock has been broken, the remaining chips tend to break away along the edges and this can rapidly deteriorate into wholesale stripping (Figure 12-5), leaving a very slick surface of exposed binder with low skid resistance.

Figure 12-5 Chip loss can occur within 48 hours after chipsealing. Photo courtesy of Les McKenzie, Opus

12.4 Other Failure Modes

Most practitioners generally accept that the most common failures following a reseal are either flushing, bleeding or chip loss. Other types of failures, not necessarily in order, can be:

- Chip rollover (including damage from power steering).
- Streaking caused by binder applied too cold.
- Delamination of PMBs and first coats constructed in winter.
- Potholing.
- Cohesive and adhesive failures.

Causes of these failures include:

- Construction faults, such as blocked jets and height of spraybar which cause irregular streaky application of the bitumen.
- Failed pre-reseal repairs.
- Poorly repaired digouts and base failures.
- Increase in heavy traffic loading.
- Diluent content too high.
- Low bitumen application rates.
- Shaded cooler areas, e.g. beneath over-bridges, structures, trees, etc.

12.5 Remedial Treatments

For future reseals, and to eliminate as many of the failures outlined in Sections 12.2 and 12.3 as possible, finding out why a new seal has failed and then choosing the correct method to repair the problem is very important.

> The design life of repairs should at least equal the design life of the original seal coat. But preventing the problem is better than having to treat it. For example, if the failure mode is a flushed or bleeding section of seal which is being tracked down the road, the first priority is to treat the source of the problem to prevent further tracking.

It is not uncommon to see a very flushed and sometimes bleeding seal just before the start of a brand new seal that has been tracked on to the new seal. There the additional binder film on the new seal can cause further bleeding and tracking problems.

Stripping or chip loss can be caused by dirty chip which is not necessarily accompanied by binder deficiency.

> Obviously a good seal design for the original seal coat to avoid stripping or chip loss is preferred, rather than repairing a seal.

Good seal design can be achieved by using harder binders where climate permits, minimising diluent content, not sealing in cold temperatures, and if necessary using a PMB. Remember that although using a PMB may prevent bleeding and tracking, it will not prevent flushing. These principles should also be used in deciding the appropriate repair methods.

In determining the appropriate treatment for a flushed area, it is essential to keep in mind the mechanism that caused the problem.

For example, in a flushed pavement, the cause is layer instability if the problem is a high binder:stone ratio (described in Section 4.7.4.2). For this problem, water blasting is not cost-effective and is only a temporary fix. See Section 6.5.5 and subsections for the analysis and treatment of layer instability.

If rain after sealing is the cause of a stripped pavement in which binder is not deficient, a hot-rolled chip may work. But if the cause was dirty chip, then hot-rolled chip may not work because the original binder is probably contaminated with too much dust.

Treatments can be divided into:

- Treatments for localised failures: can include high pressure water treatment, hot chip, diluent and chip, sandwich sealing, wet lock, and small digouts.
- Treatments for area-wide major failures: where significant or severe loss in design life has occurred, repairs can include the use of fabric (geotextile), open graded mixes, granular overlay, digout and replace, and recycling.

These treatments should be expected to restore the integrity of the pavement surface so that subsequent resealing will last at least as long as the normal design life.

Sometimes the expensive fix is more productive than repeatedly using a high risk cheaper option that is likely to fail. If too much binder is present throughout the layers of chipseals, the best option may be to strip off all the seals (i.e. an Area-wide Pavement Treatment (AWPT) discussed in Section 12.7), or recycle the pavement, because under some conditions a surfacing treatment will be all but impossible to get right.

12.6 Treatments for Localised Failures

12.6.1 Water Blasting

Water blasting (high pressure water treatment) was trialled in New Zealand in the late 1990s (Figure 7-11) and has rapidly replaced the pavement burner as a method of removing excess binder and the pavement burner is now banned (see p.250).

The different types of high pressure water treatments that are available are outlined in Section 7.3.4.2.

All high pressure water treatment units are operator-dependent and care should be taken to avoid removing too much binder.

If binder has been pushed up to the surface by vapour pressure and it is then removed, the binder that is left may not be enough to hold the chip, and result in chip loss or loss of waterproofing.

Water blasting cannot be used on first coat seals, and is high risk even with two-coat-as-first-coat seals. There is a certain binder:stone ratio above which water blasting will not be effective (see Section 6.5.5.3).

12.6.2 Gritting

In the past, common practice has been to lay grit or sand on a flushed chipseal. This is no longer encouraged as field observations have regularly shown that the sand fills the voids between the chips, pushing the bitumen even higher, and making the flushing worse.

For example, Figure 7-12 shows a flushed surface which has been aggravated by gritting (on the left of the photo). A depth of about 5 mm flushed binder was successfully removed in this case by high pressure water treatment, restoring the texture as shown on the right of the photo.

12.6.3 Hot Chip Treatment

The hot chip technique can only be used to treat localised areas where chip loss has occurred, and is usually used when the binder is still soft and a bond can be easily obtained. As such it can be used for the early treatment of construction faults. An advantage of this system is that less diluent or cutter is needed which minimises the risk of future flushing.

Hot chip (often precoated) is obtained from a hot mix asphalt plant. The production temperature depends on the haul distance between plant and job but is normally in the range of 160–190°C. If the chip is precoated the temperature should not be allowed to rise above about 170°C. Above this temperature the precoating bitumen could oxidise too rapidly and, if kept at such high temperatures, the equivalent of 1 to 2 years ageing can occur in a matter of hours.

If uncoated hot chip seems to have a significant quantity of dust, and even though the chip may have a high cleanness value, the dust source could be the hot mix asphalt plant. If so, the plant must be checked to ensure that the drum or pug mill have been well cleaned.

Hot chip can be used by itself (without binder) when enough excess binder remains on the road. However it will not work where the in-situ binder, although enough, is contaminated with fines.

Hot chip can also be used with an application of binder, usually with cutback, or an emulsion binder. In some circumstances emulsion could be the preferred choice as it is more suited to lower application rates than hot bitumen. If extra binder is applied, use only the minimum required so that the repair does not flush as a result of excess binder.

For hot chip, the choice of chip grade depends on the existing underlying chip, traffic stress, and quantity of excess binder. Grades 4, 5 or 6 can be used where no extra binder is required. To ensure full embedment of the chip into the binder, it should always be rolled.

Repair of chip loss on older chipseals is covered in Section 7.3.4.1. Another option for repair is diluent and chip, as described below.

12.6.4 Diluent and Chip

The application of a solvent to a flushed seal or to a seal that is showing chip loss, and then applying chip, is a technique that has been widely used in New Zealand as a localised treatment. The choice of solvent has often been kerosene, as mineral turpentine has a lower flash point and is thus a greater safety hazard. The application rate of the solvent is usually between about 0.1-0.3 ℓ/m^2, and can be applied with a sprayer (Figure 12-6). Adhesion agent may also be required in the solvent mix.

When using diluent and chip, the size of the chip is typically two grades finer than the existing chip (see Figure 12-7). The chip chosen will depend on the quantity of excess binder, and the size of the underlying existing chip. The aim is to get the chip to lock between the existing chips. Grades 4, 5 and 6 are the most common sizes used although Grade 3 has been used at some sites. To improve the success rate of this process precoated chips should be used.

Figure 12-6 Solvent (e.g. kerosene) being applied before it is covered with chip.

Photo courtesy of Mark Owen, Transit NZ

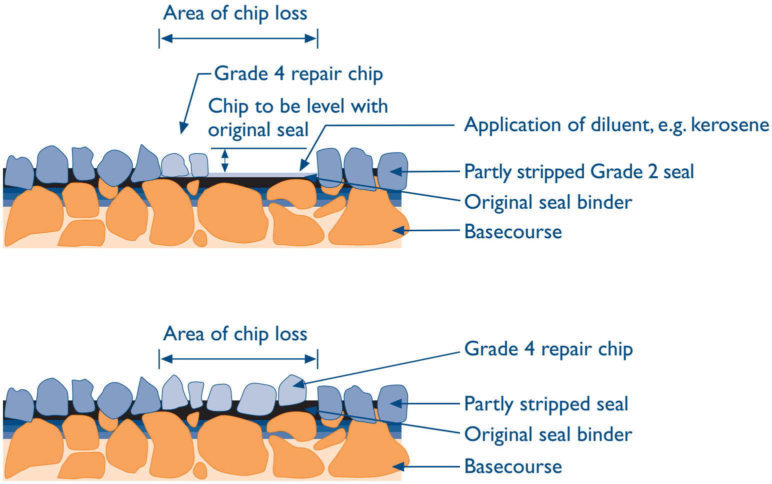

Figure 12-7 Repair of chip loss using diluent and chip.

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Diluent and chip should be applied when the air temperature is at least 18°C, and preferably in sunny weather, to ensure that the pavement temperature is as high as possible.

This treatment should be regarded as a relatively high-risk temporary treatment because chip loss can occur. It can also be regarded as a texturing treatment before a reseal. The newly spread chip should always be rolled.

Care needs to be taken in choosing this treatment when any evidence is seen of past flushing. Adding kerosene to the surface modifies the viscoelastic properties of the binder near the surface, and not all the kerosene evaporates off. This could mean acceleration or exacerbation of longer term flushing problems in future surfacing treatments.

12.6.5 Sandwich Sealing

Sandwich seal treatment is appropriate for areas that have flushed through trapped water vapour pressure or chip embedment. It can also be used in place of a texturiser and reseal if the underlying chipseals are stable. It is not advocated for use where the underlying chip seals are unstable.

The sandwich seal technique originated in France and has been used in New Zealand (especially the Napier region) since 1995. It essentially consists of the following construction sequence:

1. large chip (lowest layer);
2. binder;
3. small chip (in surface layer).

Depending on the site a light tack coat of binder can be applied before the first chip. As the binder application rate is only approximately 2/3rd of the binder used for a conventional two coat seal, a sandwich seal (Figure 12-8) has the capacity to absorb excess binder that may exist in the failed seal. Although some seals have used a PMB, successful treatments have been constructed with 80/100 and 130/150 penetration grade bitumens. This design is discussed in Sections 3.7.10 and 9.7.3.

Sandwich sealing has also been used successfully on areas of high stress. As most major roading contractors are now familiar with the technique it can be regarded as a proven treatment but it depends on the design application rate of binder for its success. This system has also been used successfully in the South Island for flushing in wheelpaths.

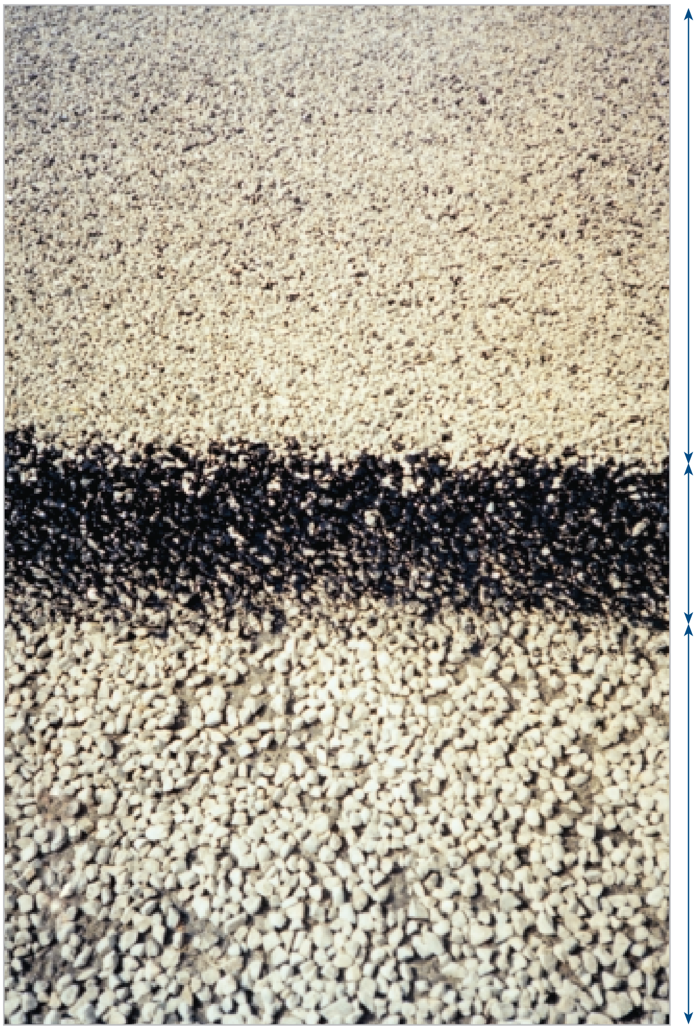

Figure 12-8 The three layers of a sandwich seal are shown part way through construction.

Photo courtesy of Laurence Harrow, Opus

12.6.6 Wet Lock

This chipseal system can be used when a single coat seal is showing signs of chip loss, particularly early in its life, and is exhibiting signs of wheelpath stripping. It essentially consists of a light seal coat of cutback or emulsion (plus adhesion agent if required) combined with a sealing chip that is one or two sizes smaller than that of the original seal coat.

Care needs to be taken with the application rate used for a wet lock to avoid flushing. For example if using a Grade 5 chip, the residual binder application rate would be expected to be somewhere between 0.5 ℓ/m^2 and 0.8 ℓ/m^2.

Binder enrichment coats may be an option for older seals where the binder is hardening and chip loss is starting, especially if traffic has increased since it was first constructed.

12.6.7 Removal of Remaining Chip

In an extreme case of stripping where a high percentage of chip has come off, the removal of the remaining chip by grader or similar means should be considered, and a new seal should be designed that makes allowance for the residual binder that will be present.

12.7 Treatments for Major Area-wide Failures

12.7.1 General

Details of most of the treatments listed below are supplied in Chapter 7 and other chapters. However, for information and assistance in decision making, a brief outline is given here as well.

12.7.2 Use of Fabrics

A fabric (or geotextile) can be used on a flushed surface. As the fabric has the ability to absorb binder, estimating the quantity of binder to apply so that the binder is sufficient to hold the chipseal as well as to saturate the fabric is very difficult.

The procedure (see Figures 3-25 and 3-26) is to:

- design an application for a tack coat that will account for the excess binder on the existing flushed surface;
- reduce the application rate if appropriate to allow absorption of the excess binder;
- apply the tack coat over the existing surface;
- apply fabric;
- apply new seal.

The problem to be avoided is reducing the binder rates too much so that insufficient binder is available to hold the new seal. In such cases, the chip would be expected to be lost at the beginning of winter.

The design for fabric (geotextile) seals is outlined in Chapter 9 and described in Chapter 3. Some local authorities are reporting success with the technique, but further research is required before it should be regarded as a useful treatment.

12.7.3 Open Graded Mixes

Open Graded Mixes, e.g. Open Graded Porous Asphalt (OGPA), are a very effective technique for the treatment of flushed areas (Figure 3-23). They are however relatively expensive. Of the mix types that are readily available, the TNZ P/11 high strength 'HS mix' would be the most appropriate.

TNZ P/11 HS mix is a 14 mm maximum-size mix with about 15% air voids. When laid to 25 mm thickness, a void capacity of 3.75 ℓ/m^2 will result, which is well in excess of the capacity required for absorbing excess binder. The resulting surface texture is appropriate for high-speed areas requiring high macrotexture depths.

The grading of the HS mix is denser than the other materials in the TNZ P/11 specification and has been found to be resistant to high traffic stresses. This material could be expected to have a life of at least 10 years. A point to note is that the drainage capacity of the Open Graded Mix (OGM) will not function fully because the voids are filled (or partially filled) with excess binder from the underlying flushed surface.

12.7.4 Granular Overlay

A granular overlay is a layer of granular material (particle size greater than 0.6 mm sand according to TNZ M/4 specification), constructed on top of an existing pavement (to improve its shape or increase its strength). A new first coat seal is then constructed on top of the granular overlay.

In an extreme case where a seal has failed because a build-up of multiple seal layers has resulted in an unstable layer, a granular overlay (designed in accordance with Austroads 2004) as an area treatment may be a cost-effective option.

12.7.5 Dig Out and Replace

Where foundation or shallow shear failures occur following a new reseal, dig out and replace should be considered. This is the best option as it removes the problem. Stabilisation (Austroads 1998) is another option but if the available material is already weak the repair will probably fail again.

12.7.6 Recycle

This technique has been developed in the Hawke's Bay region and is advocated for use as an area treatment where multiple seal coats have developed layer instability (Figure 12-9). The Hawke's Bay experience suggests that, where the volume of bitumen in multiple seal layers is >12% and the build-up of seals exceeds 40 mm thickness, then the pavement can have low shear strength and shallow shear can be experienced.

Figure 12-9 Recycling a multiple chipseal that has developed layer instability.

Photo courtesy of Gordon Hart, Transit NZ Napier

However, trigger points for layer instability have been shown by research (Gray & Hart 2003) to be different in different regions. Therefore it is important to investigate and establish layer instability trigger points for the roads locally (see also Section 6.5.5.3).

The recycling technique consists of:

- milling the seal coat and the flushed seal layers;
- milling the underlying basecourse, if necessary;
- incorporating cement;
- adding extra aggregate if necessary.

The treated material is then:

- re-laid;
- compacted; and
- sealed.

A full description of the technique is available in Austroads *Asphalt Recycling Guide* (1997).

Depending on the availability of aggregate in some areas, a granular overlay can be more cost-effective than recycling. This is the case for many South Island roads.

Sometimes the 'Do nothing' option can be taken because its minimum impact is better than a remedial treatment which could worsen the situation. The best approach is to consider each area case by case.

12.8 Reseals at Short Notice

12.8.1 General

One of the purposes of a Pavement Management Strategy (PMS) is to ensure that the RCA (Road Controlling Authority) receives an early warning of a possible need for a reseal, allowing time for adequate preparation, investigation and design. In spite of this precaution, in a few circumstances an unscheduled reseal may need to be carried out at very short notice. These are described below.

12.8.2 Unscheduled Skid Resistance Restoration

Many RCAs have a system of regular inspections and monitoring of the skid resistance of their roads. The most heavily trafficked roads are more likely to suffer from reduced skid resistance and the likelihood of crashes occurring on them is greater. These roads are generally checked annually, but the RCA may choose a reduced frequency for minor roads. This system should give plenty of warning of potential loss of skid resistance.

However should the system fail for whatever reason, and an old surface is below the Threshold Level of skid resistance (as defined in TNZ T/10:2002 specification), prompt action is essential.

Transit's policy on rectifying low skid resistance is contained in TNZ T/10. All RCAs should have their own formal policy on how to identify low skid resistance, and the Austroads *Skid Resistance Guide* (2005) provides advice on developing a Skid Resistance policy. Research is currently being undertaken on skid resistance measurements which may have an effect on these policies.

Note however that a simple reseal is not necessarily the automatic solution to a skid resistance problem. Repairing problems as identified by SCRIM do not always need a new reseal. Instead water blasting may be sufficient to remove surface contamination, e.g. from rubber build-up, while water cutting may be used to correct microtexture deficiencies. (The length of time that the microtexture improvement is effective after these treatments is the subject of a current Transfund study.)

12.8.3 Prevention of Progressive Chip Loss

A more common reason for requiring an urgent reseal is the development of chip loss. Chip loss typically occurs either:

- in the first winter after sealing, when the binder is cold and brittle, and the chip has still not been fully compacted by traffic; or
- late in the life of the seal, when the binder is brittle with age, and its volume has been reduced by oxidation.

Initially only a few chips will be missing. The loss of these few chips however seriously weakens the shoulder-to-shoulder bracing of the chips, which is as important as the grip of the binder in holding the chip in place. The result is more chip loss that further weakens the seal. In any road with significant traffic, the whole process can progress from 1% or 2% loss to complete chip loss over half or more of the surface in a matter of weeks or even less.

Maintenance crews must be trained to be alert to chip loss and report it to the asset manager or supervisor. The initial failures may be at a poor seal joint where there is not enough binder, or at some other localised failure, rather than a seal-wide problem. Initial chip loss needs to be checked urgently, and in severe conditions, a reseal may need to be applied within days.

A voidfill may appear to be a good solution and, in fact, will hold together seal areas that are still mostly intact. However if the seal has already suffered significant chip loss, a voidfill cannot improve already bald areas.

Rectification of the bald patches will be difficult and costly and cannot easily be achieved in winter conditions. This is a compelling reason for quick action when the chip loss is first observed in its early stages. Section 7.3.4.1 gives a discussion of the options for rectifying these problems.

12.9 Conclusion

Although this chapter is about repairing a chipseal because it has failed, it is also about its re-birth or rejuvenation. Even when a pavement fails, and comes to the end of its life, a rehabilitation or reconstruction is possible which will begin the life cycle of the pavement once again. So, although Chapter 12 may be at the end of this book it is not about an end but rather gives a signal that a beginning is about to start.

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