

BITUMINOUS SURFACING - STRIPPED SEALS

INTRODUCTION

This Technical Note provides guidance to identification of potential causes and corrective treatments for aggregate loss (commonly referred to as stripping) in sprayed seals.

Early identification of potential or emerging aggregate loss in sprayed seals provides the opportunity for corrective action before major loss occurs. Severe stripping and major loss of aggregate from a sprayed seal is a severe situation that can be expensive and difficult to correct.



Figure 1: Loss of Aggregate

LOSS OF AGGREGATE FROM A SPRAYED SEAL (STRIPPING)

Stripping, particularly in newly completed sprayed seal work, is usually the outcome of one of three major factors:

- Insufficient binder to hold the aggregate in place;
- Incorrect application rate of aggregate to the binder; and
- Inadequate adhesion between binder and aggregate.

Stripping can also occur in aged seals due to hardening of binder as a seal approaches the end of its service life.

Insufficient binder to hold aggregate in place is usually a result of incorrect design of binder application rates although it can also be an outcome of failure to correctly spray binder at the design rate or use of materials that are different to that assumed in the design.

When aggregate particles are applied to a binder placed at a designed application rate it is intended that they form an interlocking mosaic that will squeeze the binder an appropriate height up the aggregate particle thus enabling the seal to withstand the stresses of traffic.

If insufficient aggregate is applied, the mosaic does not form and less binder is 'squeezed' up the sides of the aggregate and individual aggregate particles are left unsupported leading to stripping.

When excess aggregate particles are applied, the resulting mosaic is too tight and the aggregate particles stand proud and are unable to roll over onto their sides as is assumed when calculating the binder application rate from the Average Least Dimension (ALD) of the aggregate. This results in less binder being squeezed up the sides of the aggregate than needed because they are "taller" than assumed in the design, again leading to stripping.

Inadequate adhesion can involve a range of complex and interrelated factors, including aggregate condition, binder condition, weather and construction practices as discussed below.

Binder hardening of aged sprayed seals is a normal occurrence and is usually identified by examination of binder condition, cracking and aggregate retention. Aggregate loss in aged seals may also be accelerated by a reduction in effective binder by long term absorption into pavement. Periodic maintenance strategies need to incorporate procedures for monitoring sprayed seal condition and retreatment before major deterioration occurs.

SPRAYED SEAL DESIGN

Current guidelines for sprayed seal design are incorporated in Austroads AP-T68 – Update of the Austroads Sprayed Seal Design Method. It is not necessary to repeat the design procedures in this Technical Note. Attention is drawn, however, to the need for:

- Accurate determination of traffic volume including influences related to heavy vehicles;
- Accurate determination of aggregate size in particular the ALD; and

- Appropriate determination of allowances for surface texture, embedment, binder absorption, aggregate shape, binder type, etc.

It is also important that materials used in construction, particularly the size and shape of aggregates, correspond with the dimensions and material types used as the basis of design.

CONSTRUCTION

Establishment of an effective bond between binder and aggregate is an important element in the construction of sprayed seals. The rate of development of that bond can be influenced by a range of materials and environmental factors and, until that bond is firmly established, newly completed seals are susceptible to damage by both traffic and moisture.



Figure 2: Stripping in new work

Specific factors influencing adhesion include:

- Aggregate
 - Type and condition
 - Presence of dust, moisture or undersized material
 - Type and effectiveness of aggregate precoating
 - Use of adhesion agents
- Binder
 - Binder type and viscosity
 - Viscosity of the binder at time of aggregate application
 - Cool weather and proportion of cutter oil
- Surface
 - If surface is damp
 - Influence of shaded areas
 - Use of adhesion agents
- Site Conditions
 - Rain or cool damp conditions following completion of new work
 - Protection of completed work.

Dust or moisture on aggregates will inhibit binder adhesion. Some acidic source rock types, such as quartz, quartzite and granites have a poorer affinity for bitumen in the presence of moisture than basic rock types. Undersized particles in the aggregate may also prevent proper incorporation of aggregate particles into the binder film.

Techniques for dealing with dust and undersized materials include rescreening, where necessary, and appropriate selection of type and rate of application of aggregate precoating. The use of adhesion agents in either the aggregate precoating material or binder assist in overcoming the influence of damp aggregates or poor bitumen affinity. Effective application of aggregate precoating is essential.

Binder viscosity has a major influence on the ability for the binder to effectively coat and adhere to the aggregate. Binder viscosity is a function of binder type, temperature of application, and rate at which binder cools (and increases in viscosity), pavement and air temperature and the time between spraying and aggregate application. Cutter oil is added to the binder in cool conditions to assist maintaining sufficient fluidity for incorporation of aggregate. The amount of cutter oil should be appropriate to binder type, aggregate size, pavement temperature and traffic volume. It should be no more than that necessary for effective adhesion, as excess cutter oil can cause bleeding in subsequent hot weather or excessive fluidity and variation of binder application rate through flow from high to low areas of pavement. Excessive fluidity is especially important if the wheelpaths are rutted.

Prompt covering of binder by aggregate is essential in cool conditions. In cold weather, shortening of sprayer runs may be necessary to ensure that aggregate is applied without delay.

Application of sprayed seals to damp surfaces should be avoided. Damp surfaces increase the rate of cooling of binder and increase the risk of unsatisfactory adhesion of binder to the aggregate and possibly existing surface. In cool weather, particular attention should be paid to the influence of shaded pavement areas on pavement temperature and moisture. Shaded areas e.g. under bridges, near large trees etc. may also slow down the rate of development of aggregate/binder adhesion, requiring longer periods of rolling and controlled slow moving traffic on completed work. Adhesion agent, added to the binder may assist in establishing adhesion in damp conditions, but should not be relied upon as a substitute for good work practice.

Rain on newly completed work creates the greatest risk of substantial stripping by disrupting the bond between the binder and aggregate. In extreme situations, emulsification of binder can occur by the combined action of moisture and traffic. Binder/aggregate adhesion may, however, be re-established when moisture is no longer present, provided that the aggregate is not disturbed in the meantime. It is possible, therefore, to avoid severe stripping by excluding or strictly controlling traffic on the wet surface. Careful rolling and controlled slow moving traffic may be used to establish adhesion as the surface dries out. If binder emulsification occurs, total loss of aggregate can only be avoided by exclusion of all traffic until sufficient drying has taken place to allow rolling to recommence.

Similarly, the use of damp aggregates may inhibit immediate adhesion between binder and aggregates, even when adhesion agents are used. As with wet surfaces above, a certain amount of drying must take place before there is adequate adhesion and hence damp aggregates may require additional attention to rolling and control of traffic speed.

Bitumen emulsion binders are particularly susceptible to rain damage if the emulsion is not fully set up and bitumen emulsion should not be used where there is any risk of rain on the new work.

REPAIR PROCEDURES

The earlier a problem is identified and treated, the lower the cost and generally the more successful the result. The following guide provides information on remedial treatments:

- Minor loss of aggregate due to binder deficiency or general lack of adhesion
 - Apply a surface enrichment or a size 7 seal to pin down the existing aggregate and prevent further loss. Consideration must be given to the influence of cutter oil retained in recent work and hence to possibility of bleeding if further cutter oil is used in the pin down seal or enrichment treatment. If the corrective treatment is to be placed in cool weather, it is preferable to use bitumen emulsion as the binder. Surface enrichment may only be suitable on shoulders or on lightly traffic roads and where traffic can be detoured or excluded to allow the enrichment to cure, thereby avoiding potential pick up of binder on vehicle tyres.
 - Apply aggregate, one sized smaller than that in the original seal, to the stripped areas in conjunction with a light spray of solvent to soften the binder and assist in incorporation of the additional aggregate (See VicRoads Technical Note 18). This must be undertaken in fine warm weather. Heating of aggregates may also assist in obtaining aggregate adhesion.

- Dry matting of stripped wheelpaths it involves two coats of aggregate. The first coat of aggregate, usually one sized smaller than the original seal, is spread dry. A coat of bitumen emulsion binder or cutback bitumen binder is then applied to hold the first coat of aggregate in place and act as the binder for a second coat of aggregate (usually 7 mm). Design of aggregate and binder application rates is important to the success of this form of treatment and expert advice should be sought before its use.

- Significant aggregate loss

- If a large percentage of the aggregate is lost, either in the wheelpaths or over the full width of the work, then a full reseal may be necessary in order to restore surface macrotexture. Particular consideration must be given, in the design process, to variations in surface texture and influence of embedment of aggregate into the binder remaining from the stripped seal as well as potential softening due to cutter oils retained in the binder. Where necessary, further preliminary work or corrective treatment such as pre spraying of coarse textured areas (see VicRoads Technical Note 23) may be required in order to ensure a uniform texture of the finished work.

REFERENCES

- VicRoads (2006) Technical Note 23 – Pre-Spraying of Sprayed Seal Surfaces
 Austroads (2006) Update of the Austroads Sprayed Seal Design Method AP-T68/06
 VicRoads (2006) Technical Note 18 – Treatment of Flushed Seals

CONTACT OFFICERS

John Esnouf - VicRoads, GeoPave Ph 5434 5015
 Email John.Esnouf@roads.vic.gov.au

Cliff Parfitt - VicRoads, GeoPave Ph 9881 8916
 Email Cliff.Parfitt@roads.vic.gov.au