1 Introduction

1.1 Surface dressing is a simple, highly effective and inexpensive road surface treatment if adequate care is taken in the planning and execution of the work. The process is used throughout the world for surfacing both medium and lightly-trafficked roads, and also as a maintenance treatment for roads of all kinds.

1.2 Surface dressing comprises a thin film of binder, generally bitumen or tar, which is sprayed onto the road surface and then covered with a layer of stone chippings. The thin film of binder acts as a waterproofing seal preventing the entry of surface water into the road structure. The stone chippings protect this film of binder from damage by vehicle tyres, and form a durable, skid-resistant and dust-free wearing surface. In some circumstances the process may be repeated to provide double or triple layers of chippings.

1.3 Surface dressing is a very effective maintenance technique which is capable of greatly extending the life of a structurally sound road pavement if the process is undertaken at the optimum time. Under certain circumstances surface dressing may also retard the rate of failure of a structurally inadequate road pavement by preventing the ingress of water and thus preserving the inherent strength of the pavement layers and the subgrade.

1.4 In addition to its maintenance role, surface dressing can provide an effective and economical running surface for newly constructed road pavements. Existing roads with bituminous surfacings, carrying in excess of 1000 vehicles/lane/day, have been successfully surfaced with multiple surface dressings. For sealing new roadbases traffic flows of up to 500 vehicles/lane/day are more appropriate, although this can be higher if the roadbase is very stable or if a triple seal is used. A correctly designed and constructed surface dressing should last at least 5 years before resealing with another surface dressing becomes necessary. If traffic growth over a period of several years necessitates a more substantial surfacing or increased pavement thickness, a bituminous overlay can be laid over the original surface dressing when the need arises.

1.5 The success of a surface dressing depends primarily on the adhesion of the chippings to the road surface, hence both the chippings and the road surface must be clean and free from dust during the surface dressing process. Inappropriate specifications, poor materials, and bad workmanship, can also drastically reduce the service life of a surface dressing.

1.6 This Road Note is a general guide to the design and construction of surface dressings in tropical and sub-tropical environments and draws attention to some of the more common mistakes that are made. It provides a framework on which the engineer can base more specific decisions made to suit particular local conditions thereby producing cost effective results. It also contains brief descriptions of certain other types of surface treatment.

2 Types of surface dressing

2.1 Surface dressings can be constructed in a number of ways to suit site conditions. The common types of dressing are illustrated in Figure 1.

Single surface dressing

2.2 When applied as a maintenance operation to an existing bituminous road surface a single surface dressing can fulfil the functions required of a maintenance re-seal, namely waterproofing the road surface, arresting deterioration, and restoring skid resistance. A single surface dressing would not normally be used on a new roadbase because of the risk that the film of bitumen will not give complete coverage. It is also particularly important to minimise the need for future maintenance and a double dressing should be considerably more durable than a single dressing. However, a ‘racked-in’ dressing (see paragraph 2.7) may be suitable for use on a new roadbase which has a tightly knit surface because of the heavier applications of binder which is used with this type of single dressing.

Double surface dressing

2.3 Double surface dressings are robust and should be used when:

- A new roadbase is surface dressed.
- Extra ‘cover’ is required on an existing bituminous road surface because of its condition (e.g. when the surface is slightly cracked or patched).
- There is a requirement to maximise durability and minimise the frequency of maintenance and resealing operations.

2.4 The quality of a double surface dressing will be greatly enhanced if traffic is allowed to run on the first dressing for a minimum period of 2-3 weeks (and preferably longer) before the second dressing is applied. This allows the chippings of the first dressing to adopt a stable interlocking mosaic which provides a firm foundation for the second dressing. However, traffic and animals may cause contamination of the surface with mud or soil during this period and this must be thoroughly swept off before the second dressing is applied. Such cleaning is sometimes difficult to achieve and the early application of the second seal to prevent such contamination may give a better result.
2.5 Sand may sometimes be used as an alternative to chippings for the second dressing. Although it cannot contribute to the overall thickness of the surfacing, the combination of binder and sand provides a useful grouting medium for the chippings of the first seal and helps to hold them in place more firmly when they are poorly shaped. A slurry seal may also be used for the same purpose (see paragraph 8.2).

**Triple surface dressings**

2.6 A triple surface dressing (not illustrated in Figure 1) may be used to advantage where a new road is expected to carry high traffic volumes from the outset. The application of a small chipping in the third seal will reduce noise generated by traffic and the additional binder will ensure a longer maintenance-free service life.

**Racked-in surface dressing**

2.7 This system is recommended for use where traffic is particularly heavy or fast (TRL, 1996). A heavy single application of binder is made and a layer of large chippings is spread to give approximately 90 per cent coverage. This is followed immediately by the application of smaller chippings which should ‘lock-in’ the larger aggregate and form a stable mosaic. The amount of bitumen used is more than would be used with a single seal but less than for
a double seal. The main advantages of the racked-in surface dressing are:

- Less risk of dislodged large chippings.
- Early stability through good mechanical interlock.
- Good surface texture.

Other types of surface dressing

2.8 ‘Sandwich’ surface dressings are principally used on existing binder rich surfaces and sometimes on gradients to reduce the tendency for the binder to flow down the slope.

2.9 ‘Pad coats’ are used where the hardness of the existing road surface allows very little embedment of the first layer of chippings, such as on a newly constructed cement stabilised roadbase or a dense crushed rock base. A first layer of nominal 6mm chippings will adhere well to the hard surface and will provide a ‘key’ for larger 10mm or 14mm chippings in the second layer of the dressing.

3 Chippings for surface dressings

3.1 The selection of chipping sizes is based on the volume of commercial vehicles having unladen weights of more than 1.5 tonnes and the hardness of the existing pavement. Ideally, chippings used for surface dressing should be single sized, cubical in shape, clean and free from dust, strong, durable, and not susceptible to polishing under the action of traffic. In practice the chippings available usually fall short of this ideal but it is recommended that chippings used for surface dressing should comply with the requirements of BS 63: Part 2 (1987) for the nominal size of chipping selected by the engineer. In this standard, some control of shape is ensured by the limits set for the flakiness index for each nominal size (except 6mm). Part of BS 63 is reproduced in Appendix A.

3.2 Samples of the chippings should be tested for grading, flakiness index, aggregate crushing value and, when appropriate, the polished stone value and aggregate abrasion value. Sampling and testing should be in accordance with the methods described in British Standard BS 812 (1985, 1989a, 1989b 1990a, 1990b).

3.3 Specifications for maximum aggregate crushing value (ACV) for surface dressing chippings typically lie in the range 20 to 35. For lightly trafficked roads the higher value is likely to be adequate but on more heavily trafficked roads a maximum ACV of 20 is recommended.

3.4 The polished stone value (PSV) of the chippings is important if the primary purpose of the surface dressing is to restore or enhance the skid resistance of the road surface. The PSV required in a particular situation is related to the nature of the road site and the speed and intensity of the traffic (Salt and Szatkowski, 1973). The resistance to skidding is also dependent upon the macro texture of the surface which, in turn, is affected by the durability of the exposed aggregate. This property is measured by the aggregate abrasion value (AAV). Appendix B gives recommended values of PSV and AAV for various road and traffic conditions in Britain and provides an indication of the required aggregate properties.

3.5 The nominal sizes of chippings normally used for surface dressing are 6, 10, 14 and 20 mm. Flaky chippings are those with a thickness (smallest dimension) less than 0.6 of their nominal size. The proportion of flaky chippings clearly affects the average thickness of a single layer of the chippings, and it is for this reason that Jackson (1963) introduced the concept of the ‘average least dimension’ (ALD) of chippings.

3.6 In effect, the ALD is the average thickness of a single layer of chippings when they have bedded down into their final interlocked positions. The amount of binder required to retain a layer of chippings is thus related to the ALD of the chippings rather than to their nominal size. This is discussed further in Section 5 where guidance is given on the selection of the appropriate nominal size of chipping and the effect of flakiness on surface dressing design.

3.7 The most critical period for a surface dressing occurs immediately after the chippings have been spread on the binder film. At this stage the chippings have yet to become an interlocking mosaic and are held in place solely by the adhesion of the binder film. Dusty chippings can seriously impede adhesion and can cause immediate failure of the dressing.

3.8 The effect of dust can sometimes be mitigated by dampening them prior to spreading them on the road. The chippings dry out quickly in contact with the binder and, when a cutback bitumen or emulsion is used, good adhesion develops more rapidly than when the coating of dust is dry.

3.9 Most aggregates have a preferential attraction for water rather than for bitumen. Hence if heavy rain occurs within the first few hours when adhesion has not fully developed, loss of chippings under the action of traffic is possible. Where wet weather damage is considered to be a severe risk, or the immersion tray test, described in Appendix C, shows that the chippings have poor affinity with bitumen, an adhesion agent should be used. An adhesion agent can be added to the binder or, used in a dilute solution to pre-coat the chippings. However, the additional cost of the adhesion agent will be wasted if proper care and attention is not given to all other aspects of the surface dressing process.