



Road Emulsion Association Limited

REAL Technical Data Sheet No. 4 - Surface Dressing with Bitumen Emulsion

Introduction

Surface dressing with bitumen emulsion is an old and well established process. From the 1930's emulsion was widely used because of the ease of handling on site. Until the late 1950's the type of emulsion was confined to anionic 55% and 62% since other types such as cationic were unknown in commercial terms. Subsequent to the introduction of the high binder content cationic emulsion, K1-70, there has been a steady and progressive increase in the use of emulsion, in preference to tar, bitumen and cutback bitumen binders, for surface dressing. With the introduction of polymer modified emulsions, the performance of the binder has been improved to allow the use of emulsions on more highly stressed sites. This upward trend will continue as environmental and safety considerations become more important.

Although environmental aspects are of increasing importance, it must be remembered that bitumen emulsion was successful on the basis of technical merit, and the steady growth in popularity is attributable to performance on the road. Health and Safety factors provide an important added benefit.

Technical Advantages

1. Surface dressing emulsions contain water and, as such, should not exceed a temperature of 90°C during storage and use. In this respect they are better described as warm rather than hot applied emulsions. The emulsions are designed so that at temperatures up to 85°C they can be used easily through conventional spraying equipment, while ensuring that they do not flow on the road surface after application. The slightly thixotropic nature of the emulsion assists in both of these considerations. The low temperature of handling and usage makes for easier and safer storage and offers savings in time and money when heating up to spraying temperatures.
2. The other viscosity aspect, which is not always understood, is that bitumen particles within the emulsion can be of any desired viscosity, for example 100 to 500 penetration to suit local ambient conditions. Thus relatively high viscosity road binders can be applied at low temperatures (85°C). Consequently, when the emulsion has broken, which it does rapidly, the film of binder on the road can be highly viscous, offering a strong bond between the chipping and the road surface. This does not ignore the importance of subsequent chipping embedment as a factor in stabilising the dressing, but it does offer good stability during the initial vulnerable period before embedment has been fully established.
3. This "internal" viscosity factor may be altered rapidly at the manufacturing source to meet the changing requirements of seasonal climatic conditions.
4. The use of adhesion agents is well known as an aid to surface dressing in damp weather conditions or for ensuring adhesion of the binder to "difficult" stone. These are an integral part of the surface dressing emulsion composition and remain in the bitumen film once the emulsion has broken. Consequently emulsion can be used in damp conditions and adhesion between the road surface and almost all known varieties of clean chippings is ensured.
5. When using polymer modified bitumen emulsion, the deposited binder film has good elasticity and tenacity characteristics encouraging a strong bond between binder and chippings. This

permits the use of emulsions on highly stressed sites where good chipping retention is essential.

Surface Dressing Systems

It is convenient to divide surface dressing systems into four main types as follows:-

1. SINGLE BINDER APPLICATION

(a) **Single Surface Dressing.** This method has the least number of operations, uses the least amount of material and is sufficiently robust for many situations.

(b) **Racked-in Surface Dressing.** The method used is to spray the bitumen emulsion at relatively high rates and dress with the larger chipping, (e.g., 14mm single size). Smaller chippings (e.g. 6mm) are then applied and the dressing is compacted. This technique gives early stability and a durable long life dressing is obtained.

The optimum rate of spread of the larger chippings, i.e., the initial dressing, is that which gives coverage of about 90% of the total surface. For the smaller chippings, i.e., the second dressing, a slight excess is required equivalent to about 25% coverage. The actual rates of spread depend on the type and density of the aggregate but, as a good guide, results have been achieved with about 12kg/m² for 14mm chippings and 3-4kg/m² for 6mm chippings.

2. DOUBLE BINDER APPLICATION

Double surface dressings with two spray applications are used mainly on very hard substrates.

(a) **Double Surface Dressing (Reverse Pad Coat Technique)** This method is used when the larger aggregate dressing is first applied, resprayed and dressed with the smaller aggregate. It is the reverse of the normal Pad Coat technique and has had only limited application in this country. The normal method would be to use a 14mm chipping for the first application followed by a dressing with 6mm chippings.

(b) **Inverted Double Surface Dressing (Pad Coat Technique)** The idea of an initial dressing employing small (e.g. 6mm) chippings was detailed in the original Road Note 1 in 1965 and repeated in subsequent Road Notes. When dressing on a hard substrate, where there will be no embedment to hold the chipping, a first dressing or Pad Coat is applied to provide this. On porous or variable surfaces the Pad Coat restores the surface to an even texture so that a second dressing may be satisfactorily applied.

It is desirable that the first dressing be trafficked to permit matrix formation before applying the second dressing. This interval depends on traffic densities, but with late dressings one must resist the temptation to wear the initial dressing too long. (For example, winter weather may render the surface of a 6mm dressing hazardous). The first dressing is usually of 6mm aggregate and the subsequent dressing 10mm or 14mm.

3. **Sandwich Surface Dressing** Where road surfaces are binder rich, or in hot weather on heavily trafficked single carriageways, a layer of chippings can be spread prior to a single surface dressing being applied.

4. **Slurry Surfacing Pad Coat** An alternative to the initial surface dressing with a small chipping in a Pad Coat is the use of Slurry which will similarly restore the texture. If however the profile of the road is variable with depressions in the wheel tracks, the resulting thicker layer of Slurry can cause the chippings of the subsequent dressing to be completely embedded. A Pad Coat technique with slurry surfacing taking the place of the first dressing is sometimes referred to as Combination Treatment.

Environmental Advantages

1. Bitumen emulsion contains water and should be applied at temperatures below 90°C. When the emulsion is sprayed on to the road, the vapour which surrounds the machine and the crew operating it is mainly low temperature steam.
2. After application the loss of volatile solvents to the atmosphere is kept to an absolute minimum since the binder in bitumen emulsion contains only small amounts of these, if any.
3. For the same reason, the risk of fire on the spraying machine and hazards of fuming are kept to a minimum during application and transportation.

On Site

1. Spraying Machinery

Any machine complying with the requirement of BS 1707, "Hot Binder Distributors for Surface Dressing", is suitable. It is of course necessary to calibrate each machine with emulsion beforehand to ensure that the transverse distribution is satisfactory and to establish the output from the spraybar.

2. Chippings

It has been found that bitumen emulsion is somewhat more tolerant to dust than other binders, but the chippings should conform to BS 63, Part 2 : Specification for Single-Sized Aggregate for Surface Dressing. Very dusty chippings must not be used particularly when the dust is bound to the chipping surface by dampness or clay-like material. Coated chippings also must not be used with bitumen emulsions.

3. Emulsion

- (a) Bitumen emulsion is normally delivered on site at or above the minimum recommended temperature of application. Should unavoidable delays occur on site, it may be necessary to increase the temperature. In such cases care should be taken to ensure that this does not exceed 90°C and that the emulsion is circulated during heating. Above this temperature there is a danger of the emulsion boiling and overflowing. Higher temperatures will not in any case improve the transverse distribution or materially accelerate the break time of the emulsion.
- (b) Where it is necessary to change over from the use of non aqueous binders such as cutback bitumen to bitumen emulsion or vice versa, reference should be made to the REAL Technical Data Sheet No. 3 for the recommended procedure.
- (c) Emulsion and chipping spread rates vary depending on site conditions. The recommendations of Road Note 39, Design Guide for Road Surface Dressings, should be followed.
- (d) Where samples of emulsion are required from the Binder Distributor for Quality Control purposes, the samples should be taken from the tanker spraybar in accordance with the method detailed in 'EN 58 Clause 8.3 – Sampling from Spraying Equipment' - as follows :-

Samples from spraying equipment shall be taken from the drainage valve or tap while the material is being circulated through the equipment. The emulsion shall be circulated through the spraying equipment at its normal spraying temperature for at least 10 minutes prior to taking the samples, and immediately before taking the samples at least 5 litres shall be drawn off and safely discarded.

A suitable quantity shall then be run off into a container, and two samples taken from the middle third of the container. Immediately after taking each sample, the sample container shall be covered with a loosely placed lid and the sample allowed to cool, before the lid is fixed securely.

4. **Rolling**

This should be carried out as soon as possible after the chippings have been applied, thus ensuring that they become wetted with binder, and that some early embedment takes place. An initial orientation of chippings is also formed on the surface, improving resistance to traffic stress.

5. **Sweeping**

It is essential that excess chippings are removed by a vacuum sweeper when the binder has set. Further sweeping should be carried out in the early life of the dressing.

After Care

The importance of after care cannot be over emphasised in relation to long term performance of the surface dressing, particularly when the application has been made on densely trafficked or fast roads. In these cases, it is desirable to have controlled speed traffic run on the surface as soon as possible after rolling, since this is the most effective form of compaction. Initially traffic should be controlled to a speed not greater than 10mph and this may be ensured by means such as traffic lights or STOP/GO boards. Preferably a vehicle should be used to escort convoys over the surface dressed section.

Bitumen emulsion has revolutionised the surface dressing industry. The low temperature of application required to wet and coat aggregates with highly viscous binders has provided both an improved and safer system of surface dressing.

For further information see Summary and Reference Sheets on the Association's website www.rea.org.uk

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