BITUMEN EMULSIONS

1. INTRODUCTION

The purpose of this Technical Note is to provide an overview for the use of bitumen emulsions in road construction and maintenance work.

2. WHAT ARE BITUMEN EMULSIONS?

Bitumen emulsions are dispersions of fine droplets of bitumen in water. Standard grades of emulsion comprise approximately 60% bitumen and 40% water. Grades consisting of approximately 70% bitumen and 30% water are becoming popular for sprayed seal operations. Higher bitumen content (up to 85 - 90%) emulsions are being developed but these are not in general use.

Bitumen emulsions are used for various applications and some type of emulsions include additives such as polymer or cutter. Setting and curing of emulsion involves separation and removal of water leaving solid bitumen. The type and quantity of emulsifier determines the setting characteristics of the emulsion.

Particular procedures apply to the handling and storage of bitumen emulsions and a guide is provided in Austroads/AAPA Pavement Work Tip No.2. Emulsion Handling and Storage.

Bitumen emulsion can be used in almost any application where cutback bitumen is used.

Advantages of bitumen emulsions include:
• the ability to handle with minimal or no heating; and
• the absence or significant reduction of cutter in the binder.

Disadvantages of bitumen emulsions include:
• slow initial curing rates; and
• higher cost.

3. APPLICATIONS IN SPRAYED SEAL TREATMENTS

3.1 Seal Types

Standard grades of bitumen emulsion are very fluid at ambient temperatures. They are applied cold and hence suitable for skin patching in maintenance work or sprayed seals involving small size aggregates (generally no more than 7 mm, but occasionally 10 mm depending on texture of surface being treated and required application rates).

A particular application for bitumen emulsions is in “pin down” seals that are applied to “lock down” a seal that is at risk of ravelling or stripping. Such seals can be applied in cool weather using emulsions as binders. Alternative “pin down” seals using cutback bitumen binders require the use of significant amounts of cutters which could increase the risk of bleeding following hot weather.

Standard bitumen emulsions are sometimes used with larger aggregates in multiple application seals that build up a well bound surfacing with successive applications of emulsion and smaller aggregates. Spraying temperature for standard grade emulsion is generally 40 - 60°C.

For single application seals using larger aggregates (10 mm and 14 mm) the emulsion binder content is often increased to 65 or 70%. Such emulsions require additional heating for effective spraying (generally 80 - 90°C) and are viscous enough to avoid excessive run-off. Higher binder content emulsions are often supplied as proprietary grades and may also include polymers for improved initial adhesion and enhanced performance. Manufacturer recommendations should be sought prior to using these grades.

3.2 Design Application Rates

In principle, emulsion seals should be designed to produce the same residual binder application rates as for cutback bitumen seals. Emulsion seal binders however lack the extra volume and softer nature of cutback seal binders. These different properties mean that it may be desirable to add an extra 0.1 - 0.2 litres/m² to the emulsion binder application values when spraying emulsions in cool conditions. This is to provide additional aggregate retention and assist with traffic embedment early in the life of the seal.

3.3 Construction Factors

A significant difference in the use of bitumen emulsion sealing binders and cutback bitumen is the time taken for the emulsion to gain sufficient strength to resist uncontrolled traffic. The breaking and curing of emulsion goes through two stages. The first stage, which occurs rapidly, is a breaking and adhesion of bitumen at the contact surface.
At this stage the binder still contains water and is very soft (sometimes referred to as ‘cheesy’). The second stage of curing may take several hours. During this time traffic must be carefully controlled or excluded altogether.

The secondary curing stage will be increased in cool or damp conditions so that although emulsions can be successfully applied in such conditions, particular care must be taken before permitting release to traffic.

A technique that can assist in avoiding larger sized aggregates being dislodged by traffic during the curing phase is the use of ‘rack-in’ or ‘dry lock’ treatments where a light application of a small sized aggregate (5 mm or 7 mm) is used to hold aggregate in place. This material is usually considered sacrificial and not intended to remain a permanent part of the seal.

Aggregates for emulsion seals should be precoated with bitumen emulsion or plant precoated bitumen products. Fresh diesel fuel oil and kerosene based precoating materials have been successfully used but can adversely affect the breaking and adhesion of emulsions to aggregate. The absence of precoating is considered poor practice and increases the risk of inferior work except possibly with some smaller sized aggregates. Aggregates that are used without precoating should be damp and not dry and/or dusty.

3.4 Primerseals

Bitumen emulsion is an effective binder for primerseals. The absence of cutter makes emulsions particularly suitable where it is necessary to apply a final treatment without an extended curing period. Penetration into pavement surfaces may be less than that with cutback primerbinders. Primerseals with emulsions require careful traffic control until cured and can be damaged by rain on uncured binder. Pavements must be damp (but not wet) to ensure even binder coverage without pin-holes.

3.5 Aggregate Precoat

Bitumen emulsions can be used for precoating aggregates in all types of sprayed sealing. They must, however, be specially formulated with a low binder content that enables application of a thin uniform coating of bitumen that is free of tackiness. Emulsion precoating is suitable for both aggregates that are to be stockpiled and for those required for immediate use. Precoating with emulsions on site can be messy and it is better to use plant precoating whenever possible. Plant precoated aggregates reduce contamination at stack sites.

3.6 Priming

Standard grades of bitumen emulsion are not suitable for priming as there is almost no penetration into the pavement. However, priming emulsions have been formulated to contain cutter to assist pavement penetration. Pavements must be moist (not wet) and penetration is generally less than that of cutback primers. Priming emulsions are becoming the preferred treatment in cooler winter periods, providing appropriate precautions are addressed.

3.7 Surface Enrichment

Slow setting grades of emulsion are normally used for surface enrichment to assist in emulsion running down to the base of aggregate rather than breaking on contact with the surface. Bitumen emulsion surface enrichments are more susceptible to pick-up by traffic in the uncured state and therefore traffic control is important.

4. OTHER APPLICATIONS

Other uses of emulsions in road construction and maintenance include:

• Tack coating for asphalts;
• Dust laying;
• Manufacture of cold mix – site mixed and plant mix stockpile mixtures for patching and paver laying;
• Slurry Surfacing;
• Pavement stabilisation;
• Cold Recycling of Asphalt;
• Crack filling; and
• Mulching and seeding.

5. ENVIRONMENTAL CONSIDERATIONS

Particular care is required when using bitumen emulsions when there is a likelihood of rain before the emulsion breaks and the seal is cured. This is especially important when they are used in primerseals or primes. Environmental management plans should include special provisions to manage the risk of their use in such circumstances.

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