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6.1 PLANNING AND PREPARATION FOR SEALING

General

Close attention to planning and preparation details will be necessary to produce a quality treatment.

Site Inspection

The site should be inspected well in advance of the planned date of bituminous surfacing to enable the selection or determination of:

(a) appropriate sealing treatment in accordance with Section 3.

(b) remedial treatment required to restore the pavement to a condition suitable for the surfacing treatment.

After completion of the remedial treatment, a further site inspection will be necessary to select the appropriate sealing treatment and assess the factors affecting the seal design.

(c) location of sites for handling and storage of binder and for stockpiling, precoping and loading of aggregate.

The sites should be selected so that they are:

(i) near the site of the work.

(ii) on level ground.

(iii) clear of the formation, drains, gateways, side tracks, trees, poles or other obstructions.

(iv) free of stumps, branches, tussocks, loose stones or other debris.

(v) away from dusty roads.

(vi) of suitable area and shape for handling and storage of binder or for stockpiling, precoping and loading of aggregate, as appropriate.

(vii) accessible in all weather conditions.

(d) traffic control strategy for the work.

(e) design of the surfacing treatment.

The site inspection should include an assessment of the pavement condition for determination of the following design parameters:

. binder allowance based on Surface Texture Test (T240).

. surface hardness measured by Ball Penetration Test (T271).

(f) available accommodation.

The date of the site inspection should be such that there is sufficient time to complete all the planning and preparatory action described in this section before the date of the surfacing treatment.

The pavement should also be inspected a day or two before the surfacing treatment to ensure:

. the pavement has been satisfactorily prepared to take a prime or primerseal,

or

. a primed or primersealed pavement is in suitable condition for sealing,

or

. a sealed pavement has been satisfactorily restored to take the appropriate resealing treatment.

Site Preparation

(a) Preparation of Site for Binder Handling and Storage

The site should be prepared by:

. grading to provide good drainage.
. clearing all vegetation and rubbish.
. locating storage tanks and other equipment for ease of handling and storage of binders.

(b) Preparation of Aggregate Stockpile Site(s).

Site preparation should include:
. grading the surface to provide good drainage.
. preparing and primer sealing or sealing an unsealed surface, when the site is likely to be used extensively and/or during subsequent sealing seasons.
. remove old aggregate and waste material, when it is proposed to stockpile aggregate on a previously used site.

Supply of Binder

The following actions should be taken to ensure satisfactory delivery of the binder:
. check that the type of material and its source are acceptable.
. determine the manner of supply whether by road tanker, rail tanker, sprayer, etc.
. determine special requirements relating to delivery, eg temperature.
. determine the sampling and testing procedure to be used for the contract.

The responsibility for sampling and testing will depend on the type of supply contract.

Supply and Precoating of Aggregate

(a) Stockpiles

If aggregate is supplied on a volume basis, stockpiles should be:
. rectangular in shape at base of stockpile.
. of uniform side slopes between 1.5 and 3 horizontal to 1 vertical.
. 1.2 metres high (approximately).
. located for ease of precoating and loading operations, ie. an unobstructed space of minimum 10 m width on at least one end and a minimum 3 m width on at least one side.

Stockpile sizes should be as specified, to avoid excessive movement of plant between sites. Separate stockpiles should be made for each size of aggregate at each site. A minimum distance between stockpiles measured from toes or sides should be 3 m.

Arrange for stockpile sites to be cleared of all surplus material at the completion of the works, so they will be left in a clean and tidy condition.

(b) Contracts for Supply

Contracts for the supply of aggregate involve the following action:
. call tenders
. test tender samples before acceptance
. accept most suitable tender
. arrange times, quantities and locations of deliveries
. obtain regular test results and advice of aggregate quality from Contractor. (Contracts involving Quality Assurance)

or

arrange regular sampling and testing. (Contracts not involving Quality Assurance)
. measure stockpiles
. arrange method of payment.
(c) Precoating Aggregate

(i) General

All aggregate 7 mm or larger should be precoated before use in bituminous surfacing work.

(ii) Precoating materials

Precoating materials, are described in Section 5.

The conditions which govern the effectiveness of the precoating treatments are given in Table 6.1.

Aggregate which has been precoated with diesel fuel oil based precoat should be stockpiled for at least one week before use.

Aggregate, which has been precoated with cutter oil based precoating material, should not be stockpiled for longer than a few days before use.

Aggregate, which has been precoated with tar based precoat should be stockpiled for at least two weeks before use.

Aggregate, which has been precoated with water based precoating material, should be used for sealing immediately after precoating.

Water based precoats are not suitable for use with scrap rubber bitumen or polymer modified bitumen.

(iii) Application rates

The application rates for precoating material should be such that each aggregate particle is uniformly coated and has a dull, damp appearance. No free precoating material should be evident.

**TABLE 6.1**

<table>
<thead>
<tr>
<th>Type of Precoat</th>
<th>Aggregate Condition</th>
<th>Time of Precoating Before Sealing</th>
<th>Stockpile Life*</th>
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<tr>
<td>Water based</td>
<td>Clear to slightly dusty</td>
<td>Same day or day before</td>
<td>1-2 days</td>
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<tr>
<td>Kerosene based</td>
<td>Clear to slightly dusty</td>
<td>Same day or day before</td>
<td>1-2 days</td>
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<tr>
<td>DFO based</td>
<td>Most Aggregates</td>
<td>1 Week</td>
<td>2-3 weeks</td>
</tr>
<tr>
<td>Tar based</td>
<td>All Aggregates</td>
<td>2 Weeks</td>
<td>6 weeks</td>
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Note: * Provided stockpiles are covered
Application rates will vary according to the nature, size and surface area of the aggregate. Generally, application rates will be in the range of 4 to 12 L/m³ except for absorptive aggregates which may require greater application rates.

The following field check may be made to determine whether or not the aggregate is correctly precoated:

1. Fill a plastic bag to about one third full with some of the precoated aggregate.
2. Close the top of the bag and shake it several times so that the aggregate flows over the inside surface of the bag.
3. If the inside of the bag is dusty, then the precoat has been underapplied.
4. If the inside of the bag is relatively clean with the exception of a few streaks of precoat, then the precoating rate is correct.
5. If the inside of the bag is covered with an oily coating, then the precoat has been overapplied.

(iv) Method of precoating

Aggregate should be precoated using:

1. an aggregate precoater, as described in Appendix A6.1.
2. a front end loader and hand lance, only if small volumes of aggregate are to be precoated and when a precoater, such as a Delarue loader, is not available.

The aggregate should be tipped from the loader bucket at a uniform rate as slowly as possible and, at the same time, the curtain of falling aggregate should be sprayed with precoating material at a uniform rate using the sprayer hand lance.

Turn over the stockpile of precoated aggregate with the loader bucket to improve the uniformity of precoating.

(v) Condition of aggregate

Ideally, aggregate should be precoated only when it is dry and clean. Treat the aggregate as follows:

1. If the aggregate is precoated when damp, it should be allowed to dry before being used for sealing.
2. Fines and dust should be removed from aggregate before precoating.

One method of removing fines and dust is to screen the aggregate through the drum of a Delarue loader with the nozzles turned off in the precoating head.

Another method is to prescreen the aggregate using a portable screening unit.

(vi) Stockpiled precoated aggregate

The following precautions should be taken with stockpiled precoated aggregate:

1. If stockpiled precoated aggregate is not to be used immediately, cover stockpiles with heavy plastic sheeting or hessian sprayed with bitumen or bitumen emulsion to prevent contamination by water and dust.
2. If rain appears imminent, cover the stockpiles of precoated aggregate.
3. Precoated aggregate which has dried out while stockpiled, should be precoated again before being used for sealing work.
 Aggregate, which has been precoated with water based precoating material, should not be stockpiled for more than one day before use.

**Sampling of Materials**

Materials should be sampled in accordance with RTA Test Method T600, Method of Sampling Materials used in Bituminous Work.

Before designing a seal or reseal, the aggregate should be sampled from stockpile and the ALD determined.

**Plant Requirements**

All necessary items of plant should be on site in good working order before the commencement of sealing operations.

The plant used by a typical spray gang includes:

- bitumen sprayer
- heater storage unit
- road tanker
- aggregate precoater
- aggregate loader
- aggregate spreader
- trucks with or without box spreaders
- rollers (self-propelled pneumatic tyred)
- drag broom
- rotary road broom
- vacuum broom
- tender truck
- utility truck (Foreman)
- mobile accommodation (if necessary)

Descriptions of the types of sealing plant are given in Appendix A6.1.

**Field Organisation**

A spray gang for a normal sealing operation may comprise:

- 1 foreman
- 1 ganger (penciler)
- 1 road tanker driver
- 1 sprayer driver
- 1 sprayer operator
- 1 heater attendant
- 1 loader operator
- 2 roller operators
- 3 truck drivers (aggregate trucks)
- 1 ganger truck driver
- 4 labourers

The size of the spray gang may need to be increased or decreased depending on the type and extent of the work.

**Traffic Control Strategy**

After the site inspection, plan the traffic control strategy for each particular job. The strategy must be prepared and all control of traffic carried out in accordance with RTA Specification 1002.

The traffic control strategy elements include:

(a) determination of the method of traffic control such as:
- single lane only
- full width
- side track or detour around the site

(b) preparation of detailed instructions (diagrams if necessary) of traffic control measures.

(c) arrangements for the required number of Traffic Controllers (with
clothing as specified in RTA Specification 1002) to be available at the site.

(c) arrangements for the supply and use of all necessary signs, traffic control devices and pilot vehicles where necessary.

(e) informing the public if applicable.

**Job Instructions**

For each section of the work, prepare job instructions for the Foreman or Ganger who will supervise the work. Information to be included in the job instructions comprises:

- details of the location.
- lengths and widths to be sprayed.
- sources of materials.
- type(s) of binder.
- binder application rate(s).
- procedures for fluxing and cutting back binder.
- nominal size(s) of aggregate.
- aggregate spreading rate(s).
- type of precoating material(s) and application rate(s).
- precoating procedure.
- type of adhesion agent and proportion to be used in binder.
- sketches and/or plans of the work, if appropriate.
- details of special procedures to be used for the particular work.

**Restoration of Pavement before Sealing**

Any pavement defects should be repaired and the pavement restored to a satisfactory condition before sealing.

For descriptions of methods of repairing pavement defects, refer to 'Road Maintenance Practice' published by NAASRA (now AUSTROADS) in 1975.

**6.2 HANDLING AND STORAGE OF BITUMINOUS MATERIAL**

**General**

Bituminous materials complying with relevant specifications should give satisfactory service provided they are handled and stored correctly.

Implementation of these procedures should prevent accidents and damage to, or contamination of, bituminous material.

The Bitumen Sealing Safety Guide describes the safety precautions to be taken during handling and storage of bituminous material.

**Transferring Material**

Bituminous materials are usually handled very hot and require special equipment for storage and application. Serious burns can be caused by the liquid coming into contact with the skin.

Water should not be allowed to contact hot bituminous materials, as this will cause boil over and foaming, which may lead to a fire or explosion.

The following precautions are to be taken when transferring bituminous materials:

- Flush the tank to be loaded and connecting pipelines with cutter oil to ensure they are free of water.
- Always check quantities to be loaded to ensure sufficient volume is available in the tank to allow for addition of additives and expansion when heated.
- Wherever possible transfer material by suction rather than by pumping under pressure. If material must be pumped then use the lowest pumping rate possible to avoid excess pressure.
Never unload heated materials until at least 20 minutes after the heaters are turned off.

- Bitumen emulsion should be pumped with either a purpose made emulsion pump or else a pump with low shearing action.
- Do not load cleaning oil, flux oil or cutter oil into an empty hot tank unless the temperature in the tank is below 100°C.
- To avoid contamination, always flush pipes, hoses, strainers, etc. with cleaning oil after the loading operations are finished.

### Heating

(a) Bituminous Material

Bituminous material should not be heated above the maximum temperatures shown in Table 6.2.

(b) Bitumen Emulsion

The following precautions should be taken when heating emulsion:

- Apply heat gently.
- Use gentle agitation.
- Warm pumps before use.
- On bulk tanks in cold areas electrical heating is advisable.
- Do not apply direct heat to emulsion with a fire or blow torch.
- Do not heat emulsion at a rate greater than 15°C per hour.

(c) Cutback Bitumen

The following precautions should be taken when heating cutback bitumen:

- Extreme care should be taken as the volatile vapours given off are easily ignited.

- Only heat cutback bitumen if its temperature is below the recommended minimum temperature for spraying.
- Do not heat cutback bitumen at a rate greater than 15°C per hour.
- Only heat cutback bitumen in sprayers.
- Circulate cutback bitumen in the sprayer during heating and continue circulating for at least 20 minutes after the burners have been turned off.

### Mixing

(a) Cutter Oil with Bituminous Materials

The most common procedure for adding cutter oil to bituminous material applies to the field production of cutback bitumen. A different procedure is used when adding cutter oil to scrap rubber bitumen.

Unless specified by the supplier, cutter oil should not be added to polymer modified bitumen. When cutter oil is added to polymer modified bitumen, the procedure is the same as that used when adding cutter oil to bitumen.

(i) Cutter oil with bitumen

The procedure for adding cutter oil to bitumen is:

- Check for presence of water in cutter oil using a water-finding paste.
- Alternatively, pour cutter oil into a cut-down 200 L drum before pumping into sprayer. If water is present, it can be seen at the bottom of the cut-down drum.
- Pump cutter oil at ambient temperature into the empty sprayer tank.
### TABLE 6.2
MAXIMUM HEATING TEMPERATURES FOR VARIOUS BITUMINOUS BINDERS

<table>
<thead>
<tr>
<th>Type of Material</th>
<th>Class or Grade</th>
<th>Equivalent % cutter</th>
<th>Max. Heating Temp. (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen</td>
<td>170</td>
<td></td>
<td>190</td>
</tr>
<tr>
<td></td>
<td>320</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Cutback Bitumen</td>
<td>AMC00</td>
<td>56</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>AMC0</td>
<td>44</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>AMC1</td>
<td>34</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>AMC2</td>
<td>27</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>AMC3</td>
<td>21</td>
<td>Conventional Cutter</td>
</tr>
<tr>
<td></td>
<td>AMC4</td>
<td>16</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>AMC5</td>
<td>11</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>AMC6</td>
<td>7</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>AMC7</td>
<td>3</td>
<td>160</td>
</tr>
<tr>
<td>Cutback Bitumen</td>
<td>FC2</td>
<td>25</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>FC3</td>
<td>20</td>
<td>Fast</td>
</tr>
<tr>
<td></td>
<td>FC4</td>
<td>15</td>
<td>Evaporating Cutter</td>
</tr>
<tr>
<td></td>
<td>FC5</td>
<td>10</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>FC6</td>
<td>7</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>FC7</td>
<td>3</td>
<td>160</td>
</tr>
<tr>
<td>Scrap Rubber Bitumen</td>
<td>15%</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>25%</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Polymer Modified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitumen:</td>
<td></td>
<td>Manufacturer’s</td>
<td></td>
</tr>
<tr>
<td>SBS Grades</td>
<td>4 to 6</td>
<td>recommendation</td>
<td></td>
</tr>
<tr>
<td>EVA Grades</td>
<td>C and DX</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
1. FC binders may be used in place of AMC binders, e.g. FC4 may replace AMC4.
2. For bitumen emulsion binders, refer to Section 6.10

The quantity of cutter oil pumped into the sprayer should be predetermined on the basis of the percentage of cutter oil required in the cutback bitumen and the quantity of cutback bitumen to be produced.

Pump hot bitumen (usually Class 170 bitumen) into the sprayer tank, observing all the safety precautions described in the Bitumen Sealing Safety Guide when transferring bitumen into a sprayer.

The temperature of the bitumen should be adjusted so that the resultant cutback bitumen is at the required temperature for spraying. This obviates the need to heat the cutback bitumen.
Heating of cutback bitumen should be avoided where possible.

Circulate the mixture of cutter oil and bitumen for at least 15 minutes before spraying.

(ii) Cutter oil with scrap rubber bitumen

The procedure for adding cutter oil to scrap rubber bitumen is:

Check for presence of water in cutter oil using a water-finding paste.

Alternatively, pour cutter oil into a cut-down 200 L drum before pumping into sprayer. If water is present, it can be seen at the bottom of the cut-down drum.

Immediately after digestion of a mixture of scrap rubber and bitumen (refer to Appendix A6.4), the required quantity of cutter oil is added by sucking into the bottom of the sprayer while the binder is circulating and the burners have been turned off.

Circulate the mixture of cutter oil and scrap rubber bitumen for 15 minutes before spraying.

Extreme care must be taken when adding cutter oil to scrap rubber bitumen the temperature of which may be as high as the recommended maximum of 200°C.

The safety precautions described in the Bitumen Sealing Safety Guide should be rigidly enforced during the addition of cutter oil.

(b) Adhesion Agents with Bituminous Materials

Adhesion agents are usually incorporated into the binder in the field. For the Authority's work, adhesion agents are usually dissolved in all binders including primers and primerbinders, except for bitumen emulsions. Bitumen emulsions are manufactured with adhesion agents incorporated and no further addition should be made.

Adhesion agents should be thoroughly agitated in their containers before use and when emptied, the interior of the container should be free of sediment. Gloves must be worn by personnel at all times when handling adhesion agents.

As most adhesion agents deteriorate if held at high temperatures for long periods, they should be added to hot binders shortly before spraying. When loading the sprayer, it should be at least one-third filled with binder before adhesion agent is added. The measured quantity of adhesion agent should then be added.

If adhesion agent will not pour from the drum, it may be warmed or mixed with a small quantity of cutter to make it fluid.

To ensure uniform dispersion of the adhesion agent throughout the binder, the mixture should be circulated for 15 minutes before spraying.

(c) Anti-foaming Agent with Bituminous Materials

Anti-foam solution is poured in the tank before any hot bituminous material is loaded.

Bitumen to be used for the field preparation of scrap rubber bitumen binders or synthetic polymer modified bitumen binders must not contain any anti-foaming agents.

(d) Water with Bitumen Emulsion

The procedure for adding water to bitumen emulsion is:

Add wetting agent (acid for cationic emulsions or a wetting
agent such as Teepol or Comprox for anionic emulsions) to water in the proportion of 1:1000.

. Place the required quantity of bitumen emulsion in the sprayer tank.

. Slowly add the required quantity of water to the sprayer, gently circulating the mixture during addition of water.

. Gently circulate the diluted bitumen emulsion for 15 minutes.

Emulsions should never be diluted except where the method specifically calls for it, e.g. enrichment. Addition of water should always be to the emulsion and not the other way around. Prior to the addition of water, its compatibility with the emulsion should be checked using Test Method T569. Water can be made more compatible by dosing it with an acid for cationic emulsion and a wetting agent for anionic emulsion. The dosage is approximately 5 L to 5000 L of water.

| Different types of emulsions should never be mixed. |

**Cleaning**

(a) General

Cleaning procedures should minimise the risk of:

. injury to personnel due to fire, explosion or other cause.

. damage to equipment due to fire or explosion.

. contamination of bituminous materials.

(b) Tanks Containing Bituminous Materials

Tanks include road tankers, bitumen sprayers, heater storage units, pontoons, drums and connecting pipe lines.

For specific details, refer to AS2865-1986 (Safe working in a confined space).

The following procedures and precautions should be taken when cleaning tanks which have stored bituminous materials:

(i) External cleaning

. Allow the tank to cool before being cleaned.

. Remove bituminous materials with Tarsolve or in stubborn cases, kerosene which may be applied using a hand sprayer.

. In the case of thick coatings, remove the majority of the material with a scraper after softening with kerosene.

. The safety precautions set out in the Bituminous Sealing Safety Guide must be rigidly enforced.

(ii) Internal cleaning

Additional precautions to be taken when personnel are working inside tanks used for bituminous materials are:

. Degas the tank or flush with boiling water to remove all dangerous fumes before commencing the cleaning operations.

. Isolate any mixing mechanism with a lock out tag.

. Isolate any valves used to control the delivery of bituminous materials or heat to the tank with a lock out tag.

. Any person who has to work inside the tank must retain the vehicle’s ignition key the whole time work is in progress inside the tank.
Place a large sign "Person working in Tank" on each side of the vehicle.

Disconnect the vehicle and sprayer batteries and any other power sources which are normally used.

**TABLE 6.3**

**PROCEDURES FOR CLEANING OUT TANKS**

<table>
<thead>
<tr>
<th>Material Last Load</th>
<th>Material Next Load</th>
<th>Anionic Bitumen Emulsion</th>
<th>Cationic Bitumen Emulsion</th>
<th>Bitumen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen</td>
<td></td>
<td>A</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>Cutback Bitumen</td>
<td></td>
<td>A</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>Primers &amp; Precoat*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anionic Bitumen</td>
<td></td>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Emulsion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cationic Bitumen</td>
<td></td>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Emulsion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flux Oil</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

**Procedure**

A  Drain tank and flush with kerosene or cutter oil.

B  Flush out surplus material from tank with water until water is not discoloured and drain tank and lines. Flush with kerosene or cutter oil and drain tank.

Flush out surplus cutter oil with water (about 450 L) and drain tank and lines. Heating the water to about 60°C and adding 1% non-ionic surfactant will assist in flushing the cutter oil. If cationic emulsion is to be the product for the next load, then the final flush should be carried out with 0.25% to 0.5% of hydrochloric acid added to the water.

C  Drain tank.

**Note:**  * This only applies to oil based precoats. Treat water based precoats as per cationic bitumen emulsion.
Any person working in the tank must wear an air supplied respirator.

Stand-by personnel outside the confined space shall be maintained and relieved as required.

(iii) Changing the type of material in tank

When changing the contents of a tank from one type of bituminous material to another type (bitumen, cutback bitumen or emulsion), the procedure for cleaning out the tank before refilling with a different type of material is given in Table 6.3.

(iv) Completion of the work

After completion of each job, thoroughly clean the tank, pump and pipelines with kerosene or cutter oil to ensure that all bituminous material is removed from the system.

Any emulsion left in the system may result in foaming when hot bitumen is next loaded.

(c) Tanks containing bitumen emulsion

When a cationic emulsion comes into contact with metal it can begin to break. If a pump is not flushed after use or lines are left part full of emulsion, they will clog. To achieve the high performance expected of emulsions, cleaning of the storage tank and pipelines is essential and needs to be carried out thoroughly.

The procedure for cleaning bulk storage emulsion tanks is:

. Flush thoroughly with water.
. Flush with kerosene or cutter oil. Do not use diesel, distillate, flux oil or other solvent as these materials are generally incompatible with the emulsion and may cause it to break rather than allow it to be flushed away.
. Finish cleaning by flushing with water.
. Do not flush into the emulsion tank.
. If the pump or line is already clogged with bitumen gentle heat may be applied externally at the blockage. Do not apply heat directly into the line as this will cause the emulsion in the line to break.
. Soak pumps with kerosene or cutter oil for an hour or more and flush with water. If the pump remains clogged, dismantle and clean the head with cutter oil or kerosene. Reassemble the pump.
. Reflush with water after blockage is removed.

Storage

(a) Bituminous Material

(i) Hot materials in bulk

Bituminous materials are stored hot in insulated storage tanks to have on hand an adequate supply of materials at or near their working temperatures.

The most common types of bulk storage for bituminous materials are as shown in Table 6.4.

When material is stored hot in bulk:

. Do not exceed the maximum prescribed temperature for the material as shown in Table 6.2.
. When the material is required for immediate use keep it within the recommended temperature range for spraying, e.g. bitumen 160 - 190°C.
. Do not store the materials hot for any length of time if no demand is expected, e.g. over a lengthy holiday break or the off season. Prolonged hot storage will drive
off the lighter oils and increase the viscosity of the material. It is better to let the material cool and heat it in time for use.

Materials containing additives such as adhesion agent and/or rubber should not be stored hot for more than 8 hours at temperatures above 150°C as the additives may lose their effect.

(ii) Cold materials in bulk

Bituminous materials may be stored at ambient temperatures without suffering any deterioration.

To avoid settlement when materials are stored cold in bulk and are liquid at the storage temperature, circulate them at regular intervals.

The precautions to be taken when storing cold bituminous materials in bulk are:

- Storages should be weatherproof.
- Label the storages to indicate their contents.
- Keep a written stock record of the contents of the storages, hot or cold.
- Aim to keep the same tanks reserved for the same type of material.
- Do not mix different types of materials.
- Do not mix different grades of the same materials.
- Check that any material can be pumped at ambient temperature before storing it in a tank without heating facilities.

At regular intervals circulate stored materials, such as cutback bitumen, tar and tar oil, to avoid settlement. These materials should always be circulated before being drawn from the storage for use.

(iii) Materials in drums

- Size of drums

The sizes of drums used are as shown in Table 6.5.

- Storing and stacking

  - Drums containing the same materials should be grouped in the same area.
  - Drums should be stacked in a single layer with the bung uppermost.
  - Always use the materials in order of receipt, i.e. the oldest material should be used first.

- Protection

Bituminous materials stored in drums should be stacked under cover to protect them from weather and to avoid contamination. It is particularly important to exclude moisture from bituminous materials (except emulsion and precoat) which require heating before use to minimise the risk of foaming.

(b) Bitumen Emulsion

Bitumen emulsion only remains stable and usable while the fine particles of bitumen are uniformly suspended in the water phase. Storage procedures should ensure that bitumen droplets do not settle or coagulate during storage.

Coagulation occurs more quickly at low temperatures and therefore, any bitumen emulsion stored should be well protected from frost.
When an emulsion is stored it has a finite lifetime. The extent of this lifetime is determined by the formulation, method of handling and how it is stored.

(i) Bulk storage

The precautions to be taken when storing bitumen emulsion in bulk are:

. Do not store bitumen emulsion for longer than 90 days.

### TABLE 6.4

**TYPES OF BULK STORAGE FOR HOT BITUMINOUS MATERIALS**

<table>
<thead>
<tr>
<th>Type of Storage</th>
<th>Capacity (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Tank at Depot</td>
<td>Up to 45,000</td>
</tr>
<tr>
<td>Road Tanker</td>
<td>Up to 25,000</td>
</tr>
<tr>
<td>Tank on Trailer</td>
<td>12,000 to 18,000</td>
</tr>
<tr>
<td>Pontoons</td>
<td>Up to 10,000</td>
</tr>
</tbody>
</table>

### TABLE 6.5

**SIZES OF STORAGE DRUMS**

<table>
<thead>
<tr>
<th>Material</th>
<th>Size of Drum (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flux Oil</td>
<td>200 (or bulk)</td>
</tr>
<tr>
<td>Cutter Oil</td>
<td>200 (or bulk)</td>
</tr>
<tr>
<td>Adhesion Agent</td>
<td>20 or 200</td>
</tr>
<tr>
<td>Precoat</td>
<td>200 (or bulk)</td>
</tr>
<tr>
<td>Anti-foam solution</td>
<td>20</td>
</tr>
<tr>
<td>Rubber in solution</td>
<td>200</td>
</tr>
<tr>
<td>Rubber latex</td>
<td>200</td>
</tr>
</tbody>
</table>
. Circulate bitumen emulsion at regular intervals.

. Circulation should be slow and for limited periods.

. The frequency of circulation depends on the weather and the length of time the emulsion has been in storage:
  Once every 7 days - summer
  Once every 5 days - winter

. The duration of circulation depends on the size of the tank:
  15 minutes - 5,000 L tank
  20 minutes - 10,000 L tank

. During cold periods, warm the bitumen emulsion using electrical heating.

. Warming reduces the tendency of bitumen emulsion to coagulate.

. Flush pumps before circulation, but keep flushed material away from inside of the tank.

. Warm pipes, valves and pumps before commencing circulation.

. Do not leave pipes partly full of bitumen emulsion.

(ii) Storage in drums

The precautions to be taken when storing bitumen emulsion in drums are:

. Store drums above ground in an upright position.

. Store drums under cover.

. Protect drums from exposure to frost.

. Use bitumen emulsion in order of receipt.

. Do not store bitumen emulsion in drums for longer than 90 days.

. Gently agitate drums by turning each drum over every 2 weeks.

. Such agitation minimises settlement of the fine particles of bitumen.

. Do not heat drums of bitumen emulsion over a fire.

. Where it is necessary to warm the bitumen emulsion, use purpose designed electrical heaters.

(c) Cutter Oil

Containers of cutter oil should not be stored on the job for long periods unless they are protected from rain and condensation. If containers are stored in the open for short periods, they are to be placed in such positions as to minimise the possibility of water gaining entry. This may be achieved by storing the drums on their sides.

Cutter oil storage tankers should be separated from other products at the tanker site (e.g. gas cylinders, petrol, oil, etc) by a minimum of 10 metres. If stored in sheds they should be adequately ventilated and comply with Flammable Liquid Regulations.

6.3 PREPARATION OF PAVEMENT SURFACE

Primes and Primerseals

Before priming or primersealing, the pavement surface should be prepared by:

(a) Drying

. If the voids near the pavement surface are filled with water, allow the surface to dry out by evaporation to a slightly damp condition.
(b) Sweeping

Sweep the pavement surface to remove dust, slurry and other foreign matter using:

- a rotary road broom.

The force applied by the broom should be just sufficient to remove dust without damaging the pavement surface.

- hand brooms, if necessary, in confined areas not swept by the rotary broom.

Sweeping should extend to at least 300 mm beyond each edge of the area to be sprayed.

(c) Watering

At the time of priming, the pavement should be slightly damp to the required depth of penetration of the primer.

Where the moisture has evaporated from the top 15 mm of the pavement material, the surface should be dampened by a light application of water. This is done by running a water cart over the surface at a higher speed than normal.

The purpose of watering is to:

- kill the dust.
- improve penetration of primer or primerbinder into the pavement.

Watering should not reduce either the hardness of the pavement surface or the surface penetration of the primer.

If over-watered, allow the surface to dry before priming.

Seals and Reseals

(a) On Bituminous Surfaces

Before sealing or resealing, the pavement surface should be prepared by:

(i) Drying

A damp surface should be allowed to dry. Sweeping with a rotary road broom may assist.

When using a bitumen emulsion binder the surface may be left damp.

(ii) Sweeping

Sweep the pavement surface to remove dust, slurry and other foreign matter using:

- a rotary road broom

or

- a vacuum broom.

Supplement with hand brooms, where necessary.

Sweeping should extend to at least 300 mm beyond each edge of the area to be sprayed.

(b) On Concrete Surfaces

Details of sealing over new or old concrete pavements are described in Section 7.

6.4 SPRAYING OPERATIONS

Setting Out

Set out the area to be sprayed with a string line which is secured to the pavement 300 mm outside the longitudinal edge.

The guide arm chain of the sprayer is then adjusted to the position of the string line.

Width to be Sprayed

(a) Full width spraying

Full width spraying should be carried out except in the following circumstances:
Where the maximum length of spray bar or the maximum width to be sprayed by a particular binder (e.g., 4.8 metres for scrap rubber bitumen) is less than the full width for spraying.

If unacceptable traffic delays are likely to occur.

Where the design calls for different binder application rates in adjacent lanes.

On a rough pavement, where the spray bar height will vary as the sprayer moves forward causing variations in the binder application rate.

On winding roads with small radius curves, where full width spraying would cause varying binder application rates.

(b) Single lane spraying

Single lane spraying should be carried out where full width spraying is precluded in the above.

Pavement Temperature

Use the measured pavement temperature to:

- determine the percentage of cutter oil in the binder from Appendix A6.2 (for sealing and resealing).
- ensure the pavement temperature is not below the specified minimum pavement temperature for the binder to be sprayed. For minimum pavement temperatures, refer to Tables 6.6, 6.9 and 6.11.

Quantity of Binder to be Sprayed

The procedure to be followed is:

(i) Calculate the design application rate of binder at 15°C. Refer to Section 4.

(ii) Convert the designed application rate to the application rate of hot cutback binder using Appendix A6.3.

(iii) Multiply the application rate of hot binder by the area to be sprayed to give the volume of hot binder.

This determination is carried out on RTA Form 23 (for conventional binders and polymer modified bitumen) or RTA Form 243 (for scrap rubber bitumen).

Loading the Sprayer

Transfer to the sprayer, the calculated volume of hot binder plus an allowance of 10% to ensure the sprayer pump does not pump air before the end of the run.

This allowance is included in the calculations in RTA Form 23 and RTA Form 243.

The incorporation of cutter oil and/or adhesion agent is included as part of the sprayer loading operation and should be carried out as described in this Section.

Spraying

Use a sprayer, as described in Appendix A6.1, to spray the binder.

Use hand spray equipment to spray small or odd-shaped areas.

Spray Nozzles

The spray nozzles should be of the make and type endorsed on RTA Form 354 - Sprayer Certificate.

The end nozzles may be either intermediate nozzles set with a jig or else purpose made end nozzles.

Measurement of Binder Quantity

Before commencing spraying, park the sprayer on level ground, dip the sprayer tank and record the quantity of binder.

Binder Temperature

At the time of spraying, measure the temperature of the binder. It should be within the allowable temperature range for
spraying the binder being used. Refer to Table 6.11.

Traffic Control
Stop all traffic.

Protective Paper
Lay a strip of protective paper, 1.2 m wide and of mass 120 g/m², transversely across the pavement at the start and finish of the sprayer run. Weigh the paper down with aggregate, gravel or other suitable material.

Positioning the Sprayer
Position the sprayer behind the start of the run.

Positioning Aggregate Trucks
Position the loaded aggregate trucks behind the sprayer before commencing the sprayer run.

Lowering Spray Nozzles
Lower the spray bar so that the nozzles are 250 - 300 mm above the pavement.

Commencement of Spraying
Travel the sprayer forward and commence spraying when the spray bar is over the protective paper. Check that all nozzles are producing a uniform spray pattern.

Problems Encountered in Spraying
Stop spraying immediately any nozzle is not operating correctly or any defect develops in the spraying equipment.

Maintaining Constant Speed
Maintain a constant sprayer speed to ensure a uniform application rate of binder.

Removal of Protective Paper
Before the commencement of aggregate spreading, remove the protective paper and dispose of it in a manner to minimise pollution.

Determination of Binder Quantity Sprayed
At the end of the run, park the sprayer on level ground, dip the sprayer and calculate the actual rate of application of binder.

The actual application rate should be within a tolerance of ± 5% of the ordered application rate.

If necessary, adjust the application rate of binder to ensure the ordered application rate is achieved in subsequent runs.

Overlapping at Longitudinal Joints
Where single lane spraying is used, the overlap at the longitudinal joint of adjacent runs should be 50 mm to 100 mm wide, provided the outer nozzles have been specially set with a jig unless purpose made end nozzles are used.

The overlap should be located outside the normal wheel paths of traffic and preferably should be located under lanelines.

6.5 AGGREGATE OPERATIONS

Loading
The loading operation is usually carried out with a front end loader. To avoid contamination of the aggregate:

- the bucket should not have teeth.
- a thin layer of aggregate should be left behind in the stockpile under the loader bucket.

Spreading
(a) Purpose

- To produce a uniform mat of aggregate
- To spread at the ordered rate

Excess aggregate on the surface may crush under the action of rolling and/or traffic.
A deficiency of aggregate will not give a tight mat and may result in some stone loss.

To ensure a good seal, tightly control the spread rate.

(b) Spreading Equipment

- Spreaders with rate of aggregate discharge automatically linked to road speed produce the best results.

- The Authority currently uses Cockerell spreaders in which the discharge rate is not automatically linked to road speed.

(c) Preparation for Spreading

Acceptable spread rates can be achieved with Cockerell spreaders provided the following is observed:

- Check Cockerell spreaders for evenness of gate openings and the correct operation of linkages.

- Truck bodies must be clean before aggregate is loaded.

- Before spraying commences, have sufficient loaded spreading trucks positioned behind the sprayer to cover the area to be sprayed.

- Select spreading widths to enable coverage to be achieved in a minimum number of passes. Narrow spread widths of less than 600 mm should be avoided.

(d) Spreading Procedure

- Spreading should commence immediately after spraying has started.

- The binder must be covered with aggregate as quickly as possible and in any case within:
  - 20 minutes when using conventional binder.
  - 10 minutes when using scrap rubber binder.
  - 5 minutes when using polymer modified binder.

- Where wide areas are sprayed, spreading trucks should travel in echelon.

- The spreading width is controlled by the number of gates opened. A square nose shovel may be used for blocking off part of a gate.

- Spreading should be carried out at a steady speed.

- Adjust gate openings to achieve an even curtain of falling aggregate.

- If the operation of the truck produces corrugations in the spread aggregate, spreading should be stopped and the spreading truck moved off the affected area. All corrugations should be removed by smoothing out with hand brooms.

- A check should be made on the rate of application of each run using Test Method T274.

- The appearance of the spread mat before rolling should be uniform, with some binder visible between the stones (except for emulsion sealing).

- When working half widths or lane widths the overlap width of the binder should be left uncovered.

- The spreaders must always be cleaned out when changing from one size of aggregate to another.

- To reduce the likelihood of damage to a new seal,
aggregate spreading trucks and other equipment should not turn on newly spread and rolled aggregate. Ensure that the truck tyres do not carry dirt or mud onto the new work.

- If an area has been generally underspread it should have extra aggregate added using the spreaders.

(e) Handspreading

Handspering may be carried out in small or odd shaped areas by shaking aggregate off a shovel. Do not throw or broadcast the aggregate because this will result in a non uniform cover.

Rolling of Aggregate

(a) Purpose

- To press the stones into the binder
- To move the stones so that their least dimensions are vertical
- To achieve mechanical interlock between the stones

(b) Equipment

- Self propelled pneumatic multi tyred rollers having an unballasted mass of about 7 tonnes are preferred.
  - Tyres are operated at a minimum pressure of 600 kPa.
  - These rollers do not have to be ballasted.
- Steel wheel rollers are not used because they:
  - Break down aggregate.
  - Push some aggregate particles into the base.
- Ride on the high spots, leaving aggregate in the low areas unrolled.

. Number of Rollers

Whilst only one roller may be required for small patching work, it is good practice to have two rollers on site to allow for mechanical breakdown and to assist with backrolling. However, as a guide, at least one roller is required for every 1500 m² of pavement sprayed.

(c) Procedure

- Rollers must follow as close as is practical behind the spreader. Once aggregate is spread, one roller pass must be applied to the whole area as quickly as possible. When this has been completed, rolling should proceed by overlapping each preceding pass by about one-third of the effective roller width.
- The full width of the spread aggregate must be rolled.
- Rolling should continue until the aggregate has been well embedded in the binder and a uniformly textured surface is obtained.
- Rolling should be continuous during the day and should continue for at least one hour after the last aggregate has been spread.
- Rollers must be driven at uniform speed to avoid skidding the wheels. Rolling speed should be about 15 km/h to move and settle the aggregate particles to their correct position.
- At least one pass of the rollers should be completed before traffic is allowed onto the new work.
- Particular attention should be given to rolling the untrafficked areas (centreline, between
wheeltracks and outside the wheeltracks on a 2 lane road). Lack of rolling in these areas can lead to stripping.

(d) Rolling Wet and Over Precoated Aggregate

Except for emulsion seals, reduce the amount of rolling while the aggregate is wet but resume normal rolling as soon as the aggregate dries. Traffic must be kept to a slow speed until the aggregate has dried and adhesion is achieved.

Emulsion seals have a greater tolerance towards the use of wet aggregate than other bituminous binders.

(e) Rolling in Rain on a Newly Laid Seal

If it rains during or soon after spreading the aggregate, cutback bitumen binders may emulsify. Further rolling may force the emulsified binder up the sides of the stones, causing pickup by tyres and damage to the new seal.

Rolling should be stopped, and traffic kept off if possible, until the aggregate dries out enough to enable adhesion to take place with the binder. Rolling should then be completed in the normal manner.

As an alternative, a light scatter coat of small size aggregate may be used to temporarily lock in the aggregate particles.

(f) Backrolling

Backrolling is used to reorientate the stones and reduce the voids between the aggregate particles.

On lightly trafficked roads (say up to - 250 v/l/d), one roller should continue rolling for periods up to half a day behind the spraying operations, i.e. 4-5 hours additional rolling after the initial one hour minimum rolling.

On heavily trafficked roads, traffic can provide the backrolling. To ensure uniform rolling, the traffic should be moved over the area of the seal using traffic control measures.

On deviations constructed away from traffic, backrolling should be carried out for a number of days. Particular attention should be given to shoulders and to the centreline areas.

Brooming

(a) Handbrooming

This may be used to correct minor irregularities in the spread rates with or without additional aggregate.

Aggregate must not be swept in from outside the sprayed area, as this may bring in dust.

Loose aggregate should be removed as soon as possible without damaging the seal.

(b) Drag Brooming

All prime seals and seals using 7 mm or finer aggregates should be drag broomed to provide an even cover of aggregate. This operation is carried out after initial rolling.

Aggregates larger than 10 mm tend to be dislodged by drag brooming.

Drag brooms should operate at between 5 and 10 km/h.

(c) Removing Loose Aggregate

(i) Timing

On polymer modified and scrap rubber seals, the loose aggregate can be removed immediately after rolling provided that a vacuum broom is used. Light brooming is permissible but this will leave a small amount of additional surplus aggregate which should be removed the following day.
Brooming should be deferred on other sprayed seals until the aggregate has sufficiently adhered to the binder. A light brooming may be carried out on the same day as rolling, but additional brooming will be required on the following day.

(ii) Operation

. Rotary road broom

The bristles should be uniform in length to enable setting of the broom to produce uniform sweeping. To prevent gouging of aggregate, a low pressure setting is selected.

Sweeping should commence in the centre of the pavement and progress to the edges. Surplus aggregate should not necessarily be removed in one pass - a number of light passes are preferable to prevent damage to the new seal.

With a rotary road broom it is preferable to have a roller following to ensure that any disturbed aggregate is rolled back into place.

. Vacuum broom

Vacuum broom is preferred to a rotary broom (to pick up loose aggregate and transport it) because a vacuum broom can be used on a new seal immediately following the completion of rolling.

A vacuum broom should not be stopped with full suction operating as this will damage the seal. If the vacuum broom is also fitted with small rotating brooms, care must be taken to ensure that the brooms do not dislodge the aggregate.

The aggregate recovered by a vacuum broom is suitable for re-use as sealing aggregate provided fine material and other foreign matter picked up by the vacuum broom are removed by screening.

6.6 TRAFFIC CONTROL PROCEDURES

Control of traffic is necessary in sealing work to provide for the safe movement of traffic and the protection of persons and property through and/or around the work site. Control of traffic is also necessary during the early exposure of a fresh sealing treatment to traffic. All traffic control must be carried out in accordance with RTA Specification 1002.

During spraying operations it is essential that traffic be detoured or stopped for short periods. The work should be organised so that any delay to traffic is limited to less than 15 minutes. In order to control vehicle speeds, a temporary 60 km/h speed zone should be established. This zone should extend at least 100 m beyond the limits of the work and should be left in force until after excess aggregate has been removed from the seal. Local police should be notified for surveillance to ensure that the speed limit is complied with. Nearby residents should be informed about the nature of the work and the anticipated duration.

Figures 6.1 and 6.2 are arrangement diagrams for traffic guidance schemes for sprayed sealing. For work not covered by these diagrams, reference must be made to RTA Specification 1002.
Diagram based on Fig. 5.25 from AS 1742.3-1985

NOTE: Signing arrangement below to be used at approaches to work site

Figure 6.1 Arrangement Diagram for Traffic Guidance Scheme
Two-lane, Two-way Road During Sprayed Sealing
Figure 6.2 Arrangement Diagram for Traffic Guidance
Scheme Two-lane, Two-way Road - Post Sealing

NOTE: Signing arrangement below to be used at approaches to work site.

DESIRABLE DISTANCE
D = 20 TO 40 m
6.7 PRIMING

Width to be Primed

The total width to be primed should extend 100 mm outside each edge of the subsequent seal.

The selection of full width or single lane priming should be made in accordance with Section 6.4.

Minimum Pavement Temperature

The minimum pavement temperature for priming is shown in Table 6.6.

Spraying Primer

- The temperature of the primer at the time of spraying should be within the range shown in Table 6.7.
- Primer should not be held at the spraying temperature for longer than one hour. If it is held at that temperature for longer, a repeat dose of adhesion agent should be added.

Primer Run Off

Where primer runs off the surface before soaking into the pavement, it should be applied in two applications, the first application generally being heavier than the second. The second application should not be sprayed until the first has soaked into the pavement.

Drying Time

Expected drying times of cutback bitumen primers are shown in Table 6.8.

After Care

After spraying primer, the following action should be taken:

- Inspect the pavement surface about two hours after spraying.
- Where the primer has been selectively absorbed, reprime hungry areas.
- Sweep pools of free primer onto adjoining areas.

### TABLE 6.6
MINIMUM PAVEMENT TEMPERATURE FOR PRIMING

<table>
<thead>
<tr>
<th>Type of Primer</th>
<th>Minimum Pavement Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutback bitumen - Conventional cutter oil</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>- Fast evaporating cutter oil</td>
<td></td>
</tr>
<tr>
<td>Tar</td>
<td>10</td>
</tr>
<tr>
<td>Special priming grade cationic bitumen emulsion</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: For all work not using bitumen emulsions, the pavement temperature must be rising if within 5°C of the minimum.
TABLE 6.7
PRIMER TEMPERATURES FOR SPRAYING

<table>
<thead>
<tr>
<th>Type of Primer</th>
<th>Grade</th>
<th>Temperature Range for Spraying (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutback Bitumen</td>
<td>AMC00</td>
<td>10 - 20</td>
</tr>
<tr>
<td></td>
<td>AMC0</td>
<td>35 - 55</td>
</tr>
<tr>
<td></td>
<td>AMC1</td>
<td>60 - 80</td>
</tr>
<tr>
<td>Bitumen Emulsion</td>
<td></td>
<td>Manufacturer's recommendation</td>
</tr>
<tr>
<td>Tar</td>
<td>T0.04</td>
<td>Ambient - 50</td>
</tr>
<tr>
<td></td>
<td>T0.2</td>
<td>50 - 70</td>
</tr>
<tr>
<td></td>
<td>T0.8</td>
<td>65 - 90</td>
</tr>
</tbody>
</table>

TABLE 6.8
DRYING TIME OF CUTBACK BITUMEN PRIMERS

<table>
<thead>
<tr>
<th>Weather Condition</th>
<th>Drying Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot weather</td>
<td>6 - 12 hours</td>
</tr>
<tr>
<td>Cool weather</td>
<td>12 - 24 hours</td>
</tr>
<tr>
<td>Cold or cool and damp weather</td>
<td>24 - 48 hours</td>
</tr>
</tbody>
</table>

Note: A dry primed pavement surface is one which is not tacky to the touch.
TABLE 6.9
MINIMUM PAVEMENT TEMPERATURE FOR PRIMERSEALING

<table>
<thead>
<tr>
<th>Type of Primerbinder</th>
<th>Minimum Pavement Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutback bitumen - conventional cutter</td>
<td>10</td>
</tr>
<tr>
<td>Cutback bitumen - fast evaporating cutter</td>
<td>5</td>
</tr>
<tr>
<td>Tar</td>
<td>10</td>
</tr>
<tr>
<td>Special primersealing grade cationic bitumen emulsion</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: For all work not using bitumen emulsion, the temperature must be rising if within 5° of the minimum.

6.8 PRIMERSEALING

Width to be Primersealed

The total width to be primersealed should extend 100 mm outside each edge of the subsequent seal.

The selection of full width or single lane primersealing should be made in accordance with Section 6.4.

Minimum Pavement Temperature

The minimum pavement temperature for primersealing is shown in Table 6.9.

Spraying Primerbinder

The temperature of the primerbinder at the time of spraying should be within the range shown in Table 6.10.

Before opening the road to construction traffic:

- The primed surface should be dry.

- If the primed surface is wet, cover it with a light and even application of sand.

**Maintenance**

- Repair failed areas of primed pavement using similar base material.

  Repaired areas should be primed so that the final surface is uniform.

- Where the pavement surface is commencing to show signs of wear under construction traffic, additional primer should be applied.
Primerbinder should not be held at the spraying temperature for longer than one hour. If it is held at that temperature for longer, a repeat dose of adhesion agent should be added.

**Trafficking the Primerseal**

Fresh primerseals have relatively poor stone holding ability under traffic, particularly during the first 4 to 6 hours. During this period protect the primerseal by:

- controlling the speed of traffic.
- extending the period of traffic control until aggregate is held securely.

Where the primerseal is not trafficked immediately, it should not be opened to traffic during a cold, wet period.

If the primerseal emulsifies during or after rain, cover the surface with fine aggregate to prevent pick up by tyres.

**Maintenance**

- Repair failed areas of primersealed pavement using similar base material.
- Repaired areas should be primersealed to provide a surface of uniform texture.
- If a primerseal starts to bleed, apply more fine aggregate.

### 6.9 SEALING AND RESEALING USING CONVENTIONAL BINDERS

**Curing of Primes and Primerseals**

Before sealing is carried out, the prime or primerseal should be cured. The recommended curing periods are:

- Primes
  - AMCO00 and AMCO - one week
  - AMC1 - two weeks
- Primerseals

Twelve months minimum - Refer to Section 4.

**Minimum Pavement Temperature**

Sealing and resealing should not be carried out with conventional binders when the pavement temperature is below 10°C.

**Addition of Cutter Oil and Adhesion Agent**

The procedure for adding cutter oil and adhesion agent to bitumen is described in Section 6.2.

The percentage of cutter oil in cutback bitumen should be determined from the estimated pavement temperature at the time of spraying and Appendix A6.2.

The proportion of adhesion agent used in the binder is generally 0.5% by volume but it may be necessary to use up to 1% with some aggregates.

**Spraying Binder**

The temperature of the binder at the time of spraying should be within the range shown in Table 6.11.

**Trafficking Seals and Reseals**

Fresh seals and reseals, particularly when cutback bitumen is used, have relatively poor stone holding ability under traffic on the day of sealing. During this period protect the seal by:

- controlling the speed of traffic.
- extending the period of traffic control until aggregate is held securely.

**After Care**

The seal should be regularly inspected, particularly during the early part of its life. Defects and failures should be repaired immediately after their appearance.

If rain falls within the first 24 hours of the life of the seal:

- Inspect the seal.
### TABLE 6.10
PRIMEBINDER TEMPERATURES FOR SPRAYING

<table>
<thead>
<tr>
<th>Type of Primer binder</th>
<th>Grade</th>
<th>Temperature Range for Spraying (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutback bitumen - Conventional cutter</td>
<td>AMC2</td>
<td>75 - 100</td>
</tr>
<tr>
<td></td>
<td>AMC3</td>
<td>95 - 115</td>
</tr>
<tr>
<td></td>
<td>AMC4</td>
<td>110 - 135</td>
</tr>
<tr>
<td>Cutback bitumen - Fast evaporating cutter</td>
<td>FC2</td>
<td>70 - 95</td>
</tr>
<tr>
<td></td>
<td>FC3</td>
<td>80 - 95</td>
</tr>
<tr>
<td></td>
<td>FC4</td>
<td>95 - 110</td>
</tr>
<tr>
<td>Bitumen emulsion</td>
<td></td>
<td>Manufacturer’s recommendation</td>
</tr>
<tr>
<td>Tar</td>
<td>T2</td>
<td>80 - 105</td>
</tr>
<tr>
<td></td>
<td>T5</td>
<td>90 - 105</td>
</tr>
<tr>
<td></td>
<td>T13</td>
<td>95 - 115</td>
</tr>
</tbody>
</table>

- If there is any indication of stripping, traffic should be diverted or, if this is not possible, reduce the speed of traffic.
- Speed control measures should be implemented to keep traffic speeds low until satisfactory aggregate adhesion is achieved.

### 6.10 EMULSION SEALING AND RESEALING

**General**

The procedures used in carrying out an emulsion seal differ from those used in conventional sprayed sealing.

**Type of Emulsion**

The technique described in this section is the general practice used for sealing and resealing using high bitumen content (67%+ bitumen) emulsions. Whilst conventional (60% bitumen) emulsions may be used, the maximum application rates achievable without significant runoff restricts the size of aggregate which may be used.

Emulsions used in sealing and resealing are sprayed undiluted.

**Precoating Aggregate**

Unless the aggregate to be used is very clean, it should be precoated approximately 1 week in advance of the work.
TABLE 6.11
BINDER TEMPERATURES FOR SPRAYING

<table>
<thead>
<tr>
<th>Type of Binder</th>
<th>Grade or Class</th>
<th>Range of Temperatures for Spraying (°C)</th>
<th>Min. Pavement Temp. (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen</td>
<td>170</td>
<td>160 - 190</td>
<td></td>
</tr>
<tr>
<td></td>
<td>320</td>
<td>170 - 200</td>
<td></td>
</tr>
<tr>
<td>Cutback Bitumen with Conventional Cutter</td>
<td>AMC5</td>
<td>120 - 150</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>AMC6</td>
<td>135 - 160</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMC7</td>
<td>150 - 175</td>
<td></td>
</tr>
<tr>
<td>Cutback Bitumen with Fast evaporating Cutter</td>
<td>FC5</td>
<td>120 - 140</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>FC6</td>
<td>130 - 150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FC7</td>
<td>140 - 160</td>
<td></td>
</tr>
<tr>
<td>Bitumen Emulsion</td>
<td></td>
<td>Manufacturer’s recommendation</td>
<td></td>
</tr>
<tr>
<td>- with polymer additive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- without polymer additive</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For all work not using bitumen emulsions, the pavement temperature must be rising if within 5°C of the minimum.

Freshly precoated aggregate or aggregate with an excess of precoat should not be used, as it may delay the breaking of the emulsion.

Aggregate which has previously been precoated and is damp at the time of sealing presents fewer problems in achieving initial adhesion with the binder than would be the case with conventional sealing.

Pavement Temperature

Sealing should not be carried out at pavement temperatures less than 10°C unless a polymer additive is used. Where polymer additive is used, sealing may be carried out at pavement temperatures of 5°C or greater.

Pavement Preparation

The pavement should be cleaned by sweeping as described in Section 6.3.

Heating the Emulsion

The emulsion should be heated slowly (maximum rate 15°C per hour) to between 75°C and 85°C for spraying.

The precautions described in Section 6.2 should be observed.

Spraying

The emulsion is sprayed at the designed rate determined from Section 4. It is possible to spray at application rates up to approximately 2.5 L/m² of hot emulsion. At higher application rates or on steep grades, runoff may be a problem.
Aggregate Spreading

The aggregate is spread at a rate to give a uniform single stone thickness of aggregate with the particles in shoulder to shoulder contact.

If a scatter coat is to be spread (see below), it is essential that the first aggregate is spread uniformly at the designed rate. The scatter coat is spread after the first aggregate and before rolling.

Scatter Coat

When carrying out emulsion sealing using aggregates with nominal size 10 mm or greater, a second aggregate, applied as a scatter coat, is used to lock in the aggregate particles.

The function of the scatter coat described in Section 4, is to prevent the first aggregate from rolling and being dislodged as the seal gains strength during the first days of its life.

Rolling

Immediately after the scatter coat is spread, rolling should be carried out as described in Section 6.5.

Traffic on the Fresh Seal

After 2 or 3 roller passes, traffic may be allowed to use the new seal. The speed of traffic must be restricted (usually by the use of pilot vehicles and traffic controllers) to a maximum of 40 km/hour until the seal has gained sufficient strength to be trafficked at higher speeds without aggregate being dislodged. The duration of this speed restriction is normally from 1/2 hour to 3 hours, depending on the weather conditions.

If the aggregate becomes dislodged, a further scatter coat should be immediately applied and the seal rolled.

Sweeping

Because of the slow strength development of emulsion seals when compared with conventional seals, sweeping may have to be delayed for longer than for conventional sealing, until sufficient strength has developed.

The use of a vacuum broom for initial sweeping minimises aggregate waste. Sweeping with a rotary road broom may be carried out 48 hours after sealing.

6.11 SEALING AND RESEALING USING SCRAP RUBBER BITUMEN AND POLYMER MODIFIED BITUMEN

General

The operational procedures used when sealing and resealing with scrap rubber bitumen and polymer modified bitumen are generally similar to the procedures used when sealing and resealing with conventional binders as described in Section 7.

This section describes the scrap rubber bitumen and polymer modified bitumen sealing procedures which differ from conventional sealing procedures. Comment is made of the effect on daily output of using these modified binders.

Some types of problems and failures experienced when using scrap rubber bitumen and polymer modified bitumen binders are also described in this section.

Sealing Using Scrap Rubber Bitumen Binders

(a) Field Production of Scrap Rubber Bitumen

Scrap rubber should be mixed with bitumen in a sprayer at the site of the work just before spraying.

The procedure for incorporation of scrap rubber in bitumen is described in Appendix 6.4.

Scrap rubber should not be added to bitumen containing cutter oil.

The quantity of scrap rubber to be mixed with bitumen is determined from the percentage by mass of
scrap rubber required in the rubber bitumen mixture.

The percentage of scrap rubber is dependent on the type of treatment and should be selected in accordance with Section 3.

(b) Plant

The field production and spraying of scrap rubber bitumen requires the following special plant:

. modified bitumen sprayer
. blending machine

These items are described in Appendix A6.1.

(c) Storage

The following requirements apply to the storage of scrap rubber bitumen:

. The storage tank should have a circulating facility which will effectively keep the scrap rubber particles uniformly dispersed throughout the bitumen.
. Purpose designed mixing paddles in the tank are desirable.
. Scrap rubber bitumen should not be stored overnight.

(d) Addition of Cutter Oil and Adhesion Agent

The procedure for adding cutter oil and adhesion agent to scrap rubber bitumen is described in Section 6.2.

The percentage of cutter oil to be added to scrap rubber bitumen is as shown in Table 6.12.

The proportion of adhesion agent used in scrap rubber bitumen should be 1% by volume.

(e) Sprayer Nozzles

Sprayer nozzles should comply with RTA Form 354 - Sprayer Certificate.

When spraying scrap rubber bitumen, B8 nozzles should be used.

The operation of all linkages should be checked

All nozzles should be removed and cleaned in cleaning oil after each sprayer run.

(f) Spraying Widths

Due to the high viscosity of the binders, the width of spraying scrap rubber bitumen should not exceed 4.8 m.

(g) Pavement Surface Temperature

The minimum pavement surface temperature for spraying scrap rubber bitumen is 20°C.

(h) Spraying Temperature

The temperature of scrap rubber bitumen at the time of spraying should be within the range of 190°C - 200°C.

(i) Spraying Scrap Rubber Bitumen

Scrap rubber bitumen should be sprayed in accordance with Section 6.4.

As nozzles are more likely to be blocked when spraying scrap rubber bitumen, the spray pattern should be observed continuously and spraying stopped as soon as a nozzle becomes blocked. The cause of this problem and its correction are documented "Problems and Failures" below.

As a thick vapour cloud is usually created behind the sprayer when spraying scrap rubber bitumen, extreme care should be taken to protect the travelling public. Stop all traffic when spraying scrap rubber bitumen even though spraying is usually only single lane width.
TABLE 6.12
PERCENTAGE OF CUTTER OIL IN SCRAP RUBBER BITUMEN

<table>
<thead>
<tr>
<th>Road Temperature</th>
<th>Weather Condition</th>
<th>Cutter Oil (% of Residual Binder*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 26°C</td>
<td>Fine and stable.</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Air temperature steady or rising</td>
<td></td>
</tr>
<tr>
<td>26°C to 30°C</td>
<td>Fine to overcast.</td>
<td>4% - 7%</td>
</tr>
<tr>
<td></td>
<td>Air temperature falling</td>
<td></td>
</tr>
<tr>
<td>20°C to 25°C</td>
<td>Fine and Stable.</td>
<td>4% - 7%</td>
</tr>
<tr>
<td></td>
<td>Air temperature rising</td>
<td></td>
</tr>
<tr>
<td>20°C to 25°C</td>
<td>Air temperature falling</td>
<td>7%</td>
</tr>
</tbody>
</table>

Note: * Residual binder is scrap rubber bitumen.
This would include any flux oil if it were added.

(j) Spraying Tolerance

The actual binder application rate should be within a tolerance of ±10% of the specified binder application rate.

(k) Spreading and Rolling Aggregate

Aggregate should be spread and rolled generally in accordance with Section 6.5

As scrap rubber bitumen is more viscous than conventional binders and it is more difficult to achieve the normal orientation of the aggregate, it is essential that the aggregate is:

spread immediately after commencement of spraying.

rolled immediately after commencement of spreading.

This can be achieved by having the aggregate spreaders travel close behind the sprayer followed immediately by the rollers.

All aggregate for each run should be spread within five minutes of spraying.

(l) Calculating Quantities

The calculation of quantities for spraying, including making adjustments for temperature, are more complicated with the inclusion of scrap rubber in the binder. For this reason, it is imperative to use the following forms for these calculations.
Sealing Using Polymer Modified Bitumen Binder

(a) Production of Polymer Modified Bitumen

Polymer modified bitumen is usually commercially produced by incorporating synthetic polymer modifier in bitumen at the supplier's plant. The product is then transported direct to a storage tank or sprayer near the site of the work.

For small jobs, blocks of synthetic polymer modifier may be mixed with bitumen in a sprayer to produce polymer modified bitumen. However, commercially supplied polymer modified bitumen is a more reliable product and should be favoured over the field produced binder.

(b) Storage

Polymer modified bitumen should preferably be sprayed on the day of delivery from the supplier.

If, for any reason such as adverse weather conditions, polymer modified bitumen cannot be sprayed on the day of delivery, it may be stored for a period not exceeding three days at the following temperatures:

- 120°C (maximum) - SBS polymer modified bitumen
- 140°C to 150°C - EVA modified bitumen

(c) Addition of Cutter Oil and Adhesion Agent

Unless recommended by the Supplier, cutter oil should not be added to polymer modified bitumen. The type of cutter oil should be as recommended by the binder supplier.

The procedure for adding cutter oil and adhesion agent to polymer modified binder is the same as the procedure used for mixing these additives with bitumen as described in Section 6.2.

Adhesion agents should be added to polymer modified bitumen at 1% concentration and in accordance with Section 6.2.

(d) Sprayer Nozzles

Sprayer nozzles should comply with RTA Form 354 - Sprayer Certificate.

When spraying polymer modified bitumen, A4N nozzles should be used.

(e) Pavement Surface Temperature

The minimum pavement surface temperature for spraying polymer modified bitumen is 25°C.

(f) Spraying Temperature

Polymer modified bitumen should be sprayed at the manufacturer's recommended spraying temperature.

(g) Spreading and Rolling Aggregate

When using polymer modified bitumen, aggregate should be spread and rolled in the same manner as for scrap rubber bitumen.

The aggregate spreaders and rollers should travel closely behind the sprayer.

Daily Output

When spraying scrap rubber bitumen, the daily outputs are lower than can be
achieved with conventional binders. The time taken to prepare each sprayer load of scrap rubber bitumen is extended by 2 to 2 1/2 hours, mainly due to:

- the time required to introduce scrap rubber into the sprayer.
- the time taken in digesting scrap rubber in bitumen.

Daily outputs are usually two loads per day for each sprayer.

Daily output of a spray gang may be doubled by using two sprayers, one sprayer circulating and digesting scrap rubber bitumen while the other sprayer is spraying. Alternatively, suitably equipped dog trailers or whales may be used for digestion.

When spraying polymer modified bitumens, the output is similar to that for conventional binders.

Problems and Failures

(a) Blocked Nozzles

The main problem encountered when spraying scrap rubber bitumen is the blocking of nozzles by:

- pieces of steel wire present in scrap rubber which has been produced from steel belted radial tyres.

Precaution: Check each consignment of scrap rubber for steel wire content.

- lumps of scrap rubber which have not dispersed and completely mixed with bitumen.

Precaution: Break up all lumps of rubber before feeding into the mixer.

- pieces of coke which have become dislodged from the heater tubes.

Precaution: Regularly inspect and clean the heater tubes.

When a nozzle becomes blocked take the following action:

- Stop the sprayer immediately.
- Remove and clean any blocked nozzles.

It is good practice to change all nozzles, as other nozzles may become blocked due to increasing viscosity of the binder in the nozzles while the sprayer is stopped.

- Keep the sprayer bar recirculating while the sprayer is stopped.

The viscosity of the binder increases rapidly as the nozzles cool down.

- Recomence spraying as soon as possible after changing nozzles.

Nozzle blockage is not usually a problem when using polymer modified bitumen but may be caused by pieces of coke dislodged from heater tubes.

(b) Stripping of Aggregate

Although aggregate stripping is a problem which may occur with any seal, it is more prevalent when using scrap rubber bitumen and polymer modified bitumen binders. This is probably due to the more complex chemical and physical characteristics of modified binders as they cool and affect the adhesion process.

In some cases, severe stripping has occurred during and after rain which may fall up to one or even two months after the application of the seal.

Adhesion of scrap rubber and polymer modified bitumen to aggregate is usually more difficult when using higher concentrations of scrap rubber or polymer.
To reduce the occurrence of stripping, take the following precautions:

- Seal with modified binders only when weather conditions are ideal for sealing.
- Ensure the aggregate is clean, dry and precoated.
- Ensure there is no delay in spreading and rolling aggregate.
- Continue rolling until full adhesion of the binder to the aggregate is achieved.

For details of the remedial treatment of aggregate stripping, refer to Section 7.

(c) Appearance of Flushing

During hot weather and on roads carrying heavy vehicles there is a tendency for the binder to rise up to or near the tops of the aggregate particles thus causing a loss of texture. This gives the same appearance as flushing in conventional seals. Except in severe cases, this condition does not cause a problem with modified binders.

When the amount of binder on the surface becomes excessive, the following alternative treatments should be used:

- Spread and roll fine aggregate or sand into the surface during hot weather.

  More than one application of fine aggregate or sand may be required to correct the problem.

- Apply Gilasbind to soften the binder and then spread and roll fine aggregate or sand into the surface.

6.12 GEOTEXTILE SEALING

Storage of Fabric

Before use, the fabrics should be stored in dry areas in their shipping bags. As the fabrics are generally UV sensitive they should be stored away from sunlight.

The core of the fabric roll should be PVC pipe. Cardboard cores tend to crush during handling and are affected by moisture.

A wet geofabric is unsuitable for use as the potential for aggregate stripping is increased.

Equipment

The plant used for conventional sprayed sealing operations can be used for geotextile sealing. The use of a multiflyed roller of less than 15 t mass is preferred.

In addition a fabric applicator is required. This is usually a lightweight frame attached to a loader, or other similar plant item, with a spindle to hold the roll of geotextile. A spring-loaded broom arrangement is attached at the base of the frame to press the fabric firmly onto the pavement surface to prevent wrinkling. There should be a special tension control mechanism to ensure a uniform fabric tension during application.

Frames can be manufactured locally or can usually be hired or purchased from geotextile suppliers.

Surface Preparation

For seals to be placed over natural surface or clay formations the relative compaction of the pavement should comply with the relevant specifications.

Before sealing, the surface should be cleaned, swept and given a light spray with water to promote penetration.

For seals placed on constructed cement concrete base or gravel pavements, cracks should be filled before sealing.
Tack Coat

The binder should be Class 170 bitumen, ideally without cutter oil.

However if the pavement material is relatively permeable, a small amount of cutter oil (say up to 3%) may be used in the tack coat to promote penetration.

Cutter oil should not be used in tack coats over clay pavements or heavily bound base materials, as the cutter oil will be trapped in the geotextile, leading to softening of the seal and possible aggregate stripping.

The tack coat should be sprayed wider (by 100-200 mm) than the proposed width of the geotextile, to allow the final seal to protect the edges of the geotextile.

If the geotextile is to be placed in two or more adjacent runs, the tack coat should be sprayed one run at a time, prior to placing each run of geotextile.

The overlap width for the geotextile is about 200 mm, and it must be fully saturated with bitumen to minimize the potential for aggregate stripping. To achieve this the overlap area is sprayed twice, with the second spray run overlapping the first run of geotextile by 200 mm.

Placement of Geotextile

Immediately after spraying the tack coat, the geotextile should be rolled out, using the fabric applicator, as close behind the sprayer as practicable.

The unfurling fabric should be kept as low as possible to the ground to prevent billowing and should be kept taut to minimize wrinkling. All wrinkles should be broomed out (or cut if necessary).

Adjoining or adjacent rolls should be overlapped by 200 mm, with the overlapped joint receiving additional tack coat as described above.

Placing of fabric along straight alignments is relatively straightforward.

Where the geotextile is to be placed around a curve, it should be "cut and butted" at regular intervals along the inner side of the curve (to minimise overlap thickness). Resulting overlaps should be hand sprayed with additional bitumen so that the geotextile is fully saturated.

On natural formations, the fabric should be laid as wide as possible over the shoulder area of the pavement, so as to prevent shoulder erosion and ingress of moisture. For other applications, the fabric should be applied over the full width of the pavement.

As the applicator wheels pass over the laid geotextile, check to ensure that the bitumen is visible in the wheeltracks, indicating that some penetration of bitumen into the fabric has occurred. If the bitumen has not risen through the fabric in the wheeltracks, an allowance should be made for this in the seal coat application.

For natural formations, rolling of the geotextile into the tack coat is not recommended because of the risk of pick up of the sticky fabric. Further trafficking should not occur until the aggregate is placed on the surface, otherwise vehicles will pick up the cooling bitumen and fabric.

For treated pavements, the geotextile is rolled prior to the seal coat. Rollers or vehicles should not stand on the laid fabric as this leads to a buildup of binder on the surface of the fabric.

Further bitumen should not be sprayed if the geotextile has become wet, as the presence of moisture will lead to subsequent seal loss.

Aggregate Spreading and Rolling

Immediately after laying the geotextile, aggregate should be spread on the geotextile without a further application of binder.

The aggregate should be rolled to bring the bitumen from the geotextile to the surface.
Rolling should be carried out with a light rubber tyred roller, with the rolling sequence being from the middle outwards to the edges. The sequence of operations may be either:

(a) Untreated Surfaces

- Tack coat - geotextile - small aggregate - additional binder - coarse aggregate

or

- Tack coat - geotextile - additional binder - coarse aggregate (including additional seal coats if necessary).

The second sequence of operations should only be used where the tack coat is partially absorbed by the geotextile and there is no risk of the binder and fabric being picked up by the tyres of the sprayer applying the additional binder.

(b) Treated Surfaces

- Tack coat - geotextile - seal coat - coarse aggregate - additional seal coats if necessary.

It is essential to delay the final seal if cutter oil has been incorporated in the initial tack coat. Sufficient time must be given for the volatiles to escape from the geotextile otherwise softening of the seal will occur. If too much cutter oil is used in the tack coat (eg >3%) evaporation of volatiles may take a long time to occur.

Traffic

For treated pavements, trafficking of the fabric may be permitted in extreme circumstances such as plant breakdowns and emergencies, provided traffic speeds are kept low and the time of trafficking is minimized.

Linemarking

On lightly trafficked roads only the edge lines should be painted. This will tend to direct traffic towards the centre of the road and away from the edges of the seal reducing the likelihood of rutting.

Appropriate signs indicating no centre linemarking and no overtaking on crests and curves should be erected.

At any locations with less than overtaking sight distance, the line marking should be as for a normal two lane road with marked centreline.

6.13 ENRICHMENT AND REJUVENATION

Enrichment

(a) Preparation of Materials

Details of the materials used for enrichment, cationic bitumen emulsion and cutback bitumen, are described in Section 5.

The materials are prepared for enrichment as follows:

(i) Bitumen emulsion

Cationic slow setting (CSS) bitumen emulsion is diluted with water.

Before the day of spraying check for compatibility of the emulsion with the local water (Test Method T569).

If the emulsion and local water are incompatible, thoroughly mix acid with the water before adding to the emulsion.

The degree of dilution of the emulsion should be in accordance with (d) below.
(ii) Cutback bitumen

Before spraying, cutback bitumen is generally prepared by cutting back in the field.

The percentage of cutter oil used is dependent on the road temperature.

Generally, the amount of cutter oil used varies between 20% to 50%. The percentage to be adopted is based mainly on experience. As a guide, for pavement temperatures as low as 20°C, approximately 50% cutter oil will assist the binder to flow off and around the stones into the voids. At higher road temperatures of around 45°C, approximately 20% cutter oil is required to achieve this same effect.

The proposed percentage of cutter oil in the binder should be verified by a short trial section at the commencement of the work.

Refer to (c) Trial Section below.

(b) Pavement Preparation

Before the day of the enrichment treatment, the pavement should be restored to a sound condition.

Cold mix patches which are still lively should be removed and patched with suitable base material and sealed.

Any failures or wide cracks should be repaired and sealed.

On the day of the treatment, any dirt or foreign material should be removed from the pavement surface by sweeping with a mechanically operated rotary road broom before spraying. Adherent patches of foreign matter may be removed by a steel scraper.

(c) Trial Section

At the commencement of the work, a small trial section should be enriched to assess the suitability of:

- Design application rate as determined from Section 4.
- Proportion of water:emulsion in the diluted bitumen emulsion or percentage of cutter oil in the cutback bitumen.
- Number of passes.

If necessary, the application rate, proportion of water, percentage of cutter and/or the number of passes should be adjusted to achieve the desired treatment for the remainder of the work.

(d) Enrichment Treatment

A calibrated bitumen sprayer should be used for spraying diluted bitumen emulsion. However, if a suitable bitumen sprayer is not readily available, a water tanker fitted with a pressurized spray bar may be used.

As the application rates achieved with water tankers are not as accurate as those achieved with bitumen sprayers, it is advisable to use dilutions greater than 1:1 and multiple passes as this will tend to average out the effects of the variable application rates on each pass.

(i) Enrichment using bitumen emulsion (Photographs 6.1 to 6.3)

When using bitumen emulsion for enrichment work, the following procedures apply:

- The minimum desirable pavement temperature is 20°C.
- Use a 1:1 mixture of water and CSS bitumen emulsion.
- The application rate should not exceed 0.6 L/m² of mixture for each pass of the sprayer to minimize runoff.
Freshly applied bitumen emulsion enrichment treatment

Photograph 6.1

After 2 hours

Photograph 6.2

The same seal as shown above, 5 years after enrichment - further enrichment is now required

Photograph 6.3
The number of passes is determined from the total application rate of the diluted bitumen emulsion and the application rate for each pass. Two or three passes are normal.

Spray consecutive passes in opposite directions.

Ensure emulsion is fully broken before applying the next pass.

The time between passes can vary from about one to three hours.

Two or more applications may need to be deferred until the following day.

Use S2 spray nozzles.

The following additional procedures should be used to prevent run-off when enriching roads having grades and crossfalls greater than 5 per cent:

Dilute the mixture to 3:1 or 4:1 of water to emulsion.

Keep the application rate for each pass as low as practicable.

The number of passes will be greater than for normal enrichment work.

Selection of the number of passes will depend on the degree of dilution and the total application rate required.

Bitumen emulsion may be applied to a slightly damp surface, but in no circumstances should it be applied if raining or if rain is imminent.

(ii) Enrichment using cutback bitumen

A calibrated bitumen sprayer should be used for spraying cutback bitumen. In most cases, the total residual bitumen can be applied in one pass. Table 6.13 lists the spraying temperature ranges for various grades of cutback bitumen.

(e) Application of Sand

Enrichment treatments lower the pavement skid resistance. This may be improved by a light application of sand.

Rejuvenation

(a) Preparation of Material

Commercially available rejuvenators are described in Section 5.

A rejuvenator is usually diluted with water.

Rejuvenators are generally compatible with most sources of water. However, if compatibility is a problem then a small quantity of acid should be added to the water, as determined by Test Method T569, prior to mixing and spraying of the rejuvenator.

(b) Pavement Preparation

The pavement should be restored and cleaned in the same manner as that used for enrichment.

(c) Trial Section

A trial should be conducted at the commencement of rejuvenation to assess if any adjustment is required in the dilution rate and/or application rate for the remainder of the work.

(d) Rejuvenation Treatment

Rejuvenators should be sprayed using a calibrated bitumen sprayer. If a suitable bitumen sprayer is not available, a water tanker fitted with a pressurized spray bar may be used.

The procedures for rejuvenation are:

Rejuvenators can be applied at low pavement temperatures (minimum 10°C) but higher pavement temperatures above 20°C are desirable.
Use a 1:1 mixture of water and rejuvenator.

The average application rate of the diluted rejuvenator mixture is generally between 0.35 and 0.55 L/m².

The application rate should not exceed 1.15 L/m² of mixture.

If rejuvenator is over-applied, it may soften the bitumen to such an extent that aggregate will begin to strip from the seal.

Use S2 spray nozzles.

(e) Application of Sand

Rejuvenators temporarily reduce the pavement friction level. The following procedure should be used to restore skid resistance:

Leave the rejuvenator on the pavement for at least 30 minutes before sanding to enable it to be absorbed into the surface.

The surface should be sanded at a rate of 0.5 - 1.0 kg/m² (500 - 1000 m²/m³) to restore skid resistance.

Keep traffic off the section to be treated until the rejuvenator has been absorbed by the binder.

Maintain the sand cover until skid resistance returns to normal.

Traffic Control for Enrichment and Rejuvenation

To facilitate traffic control, spraying should be carried out one lane at a time. The adjacent lane can be treated the following day. This procedure enables traffic to be diverted around the work and in the event that the binder takes longer to cure, due to unforeseen circumstances, it reduces the likelihood of having to put traffic on the sprayed area sooner than desirable.

Under no circumstances should traffic be allowed on the work until the treatment has cured. Bitumen emulsion and rejuvenators generally take between one to two hours to cure and cutback bitumen from \( \frac{1}{2} \) to 1 hour. The time taken for curing is a function of the prevailing weather conditions and road temperature.

6.14 MISCELLANEOUS TREATMENTS

Epoxy Seals

(a) General

Epoxy seals with calcined bauxite aggregate may be used to improve the skid resistance of pavements at locations subject to high acceleration or deceleration by traffic, such as at the approaches to tollgates.

(b) Binder

There are several epoxy binders available commercially. They comprise blends of either coal tar or bitumen and epoxy resin.

(c) Aggregate

The aggregate should be crushed calcined bauxite, graded to pass a 5 mm AS sieve and to be retained on an 0.5 mm AS sieve.

(d) Preparation of Pavement

If there are any failures in the pavement to be overlaid with an epoxy seal, restore the pavement to a uniform, sound condition.

To obtain the best results from an epoxy seal treatment,

- apply a thin layer of asphalt on the existing asphalt surface
  or
- mill the existing asphalt surface and overlay it with a thin layer of asphalt.

A cement concrete surface must be overlaid with asphalt before treatment.
Before applying an epoxy seal, thoroughly clean any oil or detritus from the pavement surface with detergent and allow the surface to dry before treatment.

(e) Application of Epoxy Seal

An epoxy seal treatment consists of:

- the application of epoxy binder at a rate of approximately 1 - 1.5 L/m² using
  - a mechanical sprayer
  or
  - squeegees
  or
  - brooms.
- spreading calcined bauxite aggregate, at a rate of 6 - 8 kg/m² (100 - 125 m²/m³), immediately after the binder has been applied.

Do not roll the aggregate. The random orientation and shape of the aggregate particles provides the desired texture.

**Tar Emulsion and Polymer Emulsion Seals**

Oil and diesel resistant seals may be used to treat known problem areas, such as bus stops, traffic lights, where the repeated deposition of oil and diesel spillage causes ravelling of the seal or asphalt.

The sealing treatment consists of:

- the application of tar emulsion/sand mixture
  or
- the application of polymer emulsion.

Both of the above should be followed by spreading of sand.

The treatment is usually only applied to bus stops, bus bays and bus parking areas.

The emulsions are generally applied in several applications either by squeegee, soft broom, sprayer or roller as appropriate.

Each application must be made at right angles to the previous layer.

Curing time may take up to 6 hours before the pavement is suitable for trafficking.
The time taken to cure the emulsion depends on road temperature and weather conditions.

Depending on the location, this treatment will usually last for about three years before having to be repeated.

**Slurry Seals**

(a) General

When slurry sealing is used as a shape correction treatment, it is desirable to place it in several layers. The first layer should be applied as a correction course using a special rut screed box with a metal strike-off. Successive uniform layers are applied over the correction course using a rubber strike-off. A hessian drag is used behind the strike-off.

(b) Weather Limitations

A slurry seal should not be spread when either the pavement or air temperature is below 10°C. Spreading should not be carried out during rain or if rain appears to be imminent.

(c) Pavement Preparation

The existing bituminous surface should be thoroughly cleaned. All potholes, major depressions and badly distorted areas should be repaired. Large cracks and joints should be cleaned and sealed with suitable crack sealing material.

The entire surface should be dampened, the rate of application of water being adjusted so that there is no apparent water flowing in front of the spreader box. Any water remaining in ponds on the pavement should be swept off. Normally, a tack coat is not necessary.

(d) Plant

The plant used for slurry sealing is described in Appendix A6.1.

(e) Method of Application

As the machine travels along at a uniform slow speed (maximum 55 m/min) the materials are mixed and discharged at a uniform rate into the spreader box. The mixture must flow into the moving spreader box at a sufficient rate to maintain an ample supply across the full width of the strike-off at all times.

Weighted damp hessian is trailed behind the spreader box to correct minor irregularities and smooth any joints. This hessian may trail for up to 600 mm behind the spreader to improve the surface texture.

When forming a longitudinal joint, the spreader box should overlap the previous run by up to 100 mm.

(f) Protection of Services

Precautions should be taken to prevent slurry from entering or adhering to gratings, service covers and other road fixtures. Immediately after the slurry has been spread, any material adhering to such road fixtures should be cleaned off.

(g) Setting Time

Depending on the pavement temperature and the prevailing weather conditions the treatment should set up in about 1 to 4 hours.

(h) Traffic

During the curing period, the new work must be closed to traffic.

Traffic control should be provided as for conventional sprayed sealing.

**Dust Laying**

(a) General

Dust is a nuisance which can cause traffic accidents by restricting vision and by settling on and obscuring signs. Dust can carry over on to adjacent properties and cause nuisance to owners.
Dust may be reduced by:

- frequent spraying of the surface with water
  or
- treating the surface with diluted bitumen emulsion
  or
- spraying commercially available dust palliatives.

The choice of treatment depends on:

- The cost of each treatment for the period during which the dust needs to be laid.
- The magnitude of the danger if the dust is not treated.

Commercial products should be used in accordance with manufacturer’s recommendations.

(b) Procedure Using Bitumen Emulsion

(i) Mixture

A suitable material is obtained by diluting slow setting cationic bitumen emulsion with water. The proportions required are:

<table>
<thead>
<tr>
<th>Parts (water:emulsion)</th>
<th>Type of Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>About 4:1</td>
<td>Hard</td>
</tr>
<tr>
<td>About 12:1</td>
<td>Soft</td>
</tr>
</tbody>
</table>

(ii) Preparation

Place a small quantity of water in the tank, sufficient to cover the bottom, and then add the emulsion. The remainder of the water should then be added. This should preferably be done through a pipe with its outlet below the surface of the liquid to minimise frothing. The materials must be thoroughly mixed by circulating or by moving the water tanker backwards and forwards and applying the brake for 3 or 4 times.

The material should be used shortly after preparation to avoid sedimentation and/or breaking which could block the equipment.

General precautions regarding handling of emulsions apply.

(iii) Rate of application

The rate of application of the mixture is about 1 L/m². The rate should not cause runoff. If runoff does occur, the rate should be reduced.

(iv) Traffic

Traffic should be kept off the surface until the emulsion has broken.

(v) Life expectancy

Life expectancy of bitumen emulsion treatment is about 2 to 3 days for the initial application. The application may be repeated and several applications will eventually result in a dark brown to black surface.

The expected life span between applications after the second application will depend on the pavement condition, weather and traffic but should be of the order of 3 to 4 weeks minimum. The interval between applications will increase.
PLANT

Bitumen Sprayer

(a) General

Sprayers vary in capacities from 3,000 to 10,000 litres (truck mounted). Smaller units are usually used for maintenance work.

The mechanical description of the sprayer is given in RTA Specification 1260.

Sprayers are fitted with guide arm and chain to enable the driver to follow the correct line.

(b) Sprayer Testing

Sprayers should be tested as follows:

· Sprayers should be tested and calibrated annually or more often if they are damaged or become inaccurate.

· New sprayers and sprayers which have been extensively modified are normally tested at the Authority’s BME Services at Granville, where full testing equipment is available.

· Sprayers which have been previously tested and are in operating condition, may be tested in the field by a mobile unit.

When sprayers are tested, spraying tables, attached to RTA Form 354 - Sprayer Certificate, are prepared to show pump speeds and road speeds for the various rates of spray application which may be required. These tables are not necessarily correct when the sprayer has been operating for a long period. Wear of sprayer parts may necessitate adjustment of the tables by amending the road speeds.

With the exception of machines used only for maintenance or priming, sprayers used for bitumen sealing on classified roads must hold a current Sprayer Certificate. The certificate means that, when tested the sprayer complied with the operational requirements of RTA Specification 1260.

(c) Heating Equipment

The heating equipment comprises a gas operated burner fitted to each heating tube. The fuel is delivered to the burner from a LP gas cylinder. The burner is shrouded to facilitate operation in gusty wind. A separate portable LP gas burner is provided for heating the bitumen pump, spray bar and connecting pipelines, if bituminous material solidifies in the system.

(d) Thermometers

Two mercury - in - steel dial thermometers are fitted to the tank. The thermometer elements are located:

· near the tank outlet and

· at mid-length and mid-height of the tank.

A built-in checking tube for use with a maximum recording clinical type glass thermometer is provided near the tank outlet for the purpose of checking the accuracy of the dial thermometer.

(e) Spray Bar and Spray Nozzles

The spray bar is of the fully circulating type in which the bituminous material is pumped from the tank through the full length of the spray bar and returned to the tank.
while the valves controlling the spray nozzles are closed.

This type of spray bar has the following advantages:

- The bar is completely filled with hot material before commencing to spray.
- The bar is heated with the hot material and hence bitumen adhering to the nozzles is melted off prior to commencement to spray.

The spray bar can be folded so that the width does not exceed 2.5 metres for travelling. Extension pieces of 300 mm and 600 mm lengths are provided to enable the length of the spray bar to be adjusted from 2.5 m to 7.4 m.

The height of the spray bar can be adjusted so that the lower faces of the nozzles are 250 mm to 300 mm above the ground.

The spray bar can be articulated to conform to the camber of the road and can also be moved transversely.

The valves attached to the spray nozzles are controlled by linkages which open or close all the valves.

Slot type spray nozzles are fitted and spaced at 100 mm centres along the length of the spray bar.

Except for the spray nozzles at each end of the spray bar, the intermediate nozzles are set at 30° to the bar and parallel to one another. The setting can be checked by placing a straight edge against the near faces of the square portions of the nozzles.

The spray nozzle at each end of the spray bar is usually an intermediate nozzle set at a predetermined angle (greater than 30°) using a special jig which is kept with the sprayer at all times.

Figure A6.1 illustrates the arrangement of spray nozzles and the shape of the resulting spray pattern.

Some contractors and other authorities use special end nozzles in place of the intermediate nozzles set with a jig.

Spray nozzles should receive special care, as they can be easily damaged. They need to be inspected frequently, and replaced if they are found to be worn or damaged. Spare new nozzles of the same type need to be available with the sprayer at all times.

(f) Modifications to Sprayer for Scrap Rubber Bitumen Work

Sprayers used for scrap rubber bitumen work should be modified to improve mixing and circulation of the binders and provide increased pumping capacity.

The modifications include:

- Provision of at least two paddles placed inside and near the bottom of the sprayer tank to improve circulation, particularly in the vertical direction.

  The paddles are normally attached to vertical shafts which are driven by hydraulic motors location on top of the tank.

- A larger pump operating at higher pressure as scrap rubber bitumen is more viscous than other binders at the time of spraying.

Spray nozzles with larger openings (usually B8 nozzles) are used to produce a satisfactory spray pattern.
Figure A6.1 Arrangement of Spray Nozzles and Spray Pattern
(from AUSTROADS)

Bitumen Storage Tanks

(a) Road Tankers

Road tankers vary in size from 7,000 to 25,000L capacity and are insulated and fitted with heating tubes, burners and pumps.

Road tankers are used to transport bulk material for longer distances where rail services are inadequate.

(b) Fixed Tanks at Depots

Fixed tanks vary in size up to 45,000L capacity. They are insulated and fitted with heating tubes, burners and pumps.

(c) Dogs

For operations in the field these units are mounted on a trailer chassis. They are designed to store and heat bulk materials, but are emptied for transport. Tanks of between 12,000 to 18,000L capacity are in common use.

(d) Pontoons

These are steel tanks with a capacity of up to 10,000L fitted with integral heating tubes. They can be loaded with hot material at the source of supply and transported to the field by road or rail. They are used for supplementary storage at the site of the work or at a depot.
Aggregate Precoater

The precoater most commonly used by the Authority is a continuous mechanical aggregate loader (Delarue).

This type of precoater comprises:

. gathering spirals which feed the aggregate transversely along the ground to a centrally located bucket elevator.

. a bucket elevator to lift the aggregate from the ground to a cylindrical screen.

. a rotating cylindrical screen which screens out fine particles, dropping them to the ground under the machine.

. a swivelling conveyor which moves the screened aggregate from the cylindrical screen to the precoating chamber.

The swivelling conveyor can be swivelled at an angle to the centre line of the loader thus controlling the width of the stockpile of precoated aggregate.

. a precoating chamber fitted with spray nozzles, located adjacent to the head pulley, and baffles to roll the stones as they fall from the precoating chamber into the stockpile.

This rolling improves the spread of precoating material over the surfaces of the stones.

Trailer mounted precoating machines without any screening ability are also available. These are also suitable provided that they are fitted with an effective system of baffles and spray bars.

Aggregate Loader

Rubber tyred front end loaders are usually used for loading aggregate from stockpile into trucks.

The capacity of the loader should be sufficient to balance the output of the sprayed sealing operation. A bucket without teeth is preferable to minimise the contamination of the aggregate.

Aggregate Box Spreaders

The main type of aggregate spreader used by the Authority is the Cockerell truck mounted box spreader.

A box spreader comprises a hopper attached to the rear of the truck body and extending across the full width.

Aggregate is discharged through several separate adjustable gates.

The spreader is controlled as follows:

. Width of spread

  The width can be varied by opening the appropriate number of gates.

  Each gate is about 600 mm wide. The maximum width of spread, with all gates open, is about 2.4 m.

. Spreading rate

  The spreading rate is controlled by the height of the gate opening.

  Some box spreaders are fitted with air operated controls.

Aggregate Auto Spreader

An auto spreader comprising of a fantail with calibrated gates which can be separately opened or closed. The operator controls the aggregate spread rate, as well as opening and closing aggregate distribution gates.

Trucks

Until recent years, trucks used for spreading aggregate were standard two axle vehicles fitted with a 5 to 6 m$^3$ capacity tipping body.

For economic reasons, the trend is to use larger trucks with single steering axle, tandem driving axles and fitted with a 9 to 10 m$^3$ capacity tipping body.
For small jobs, the 5 to 6 m³ capacity trucks may be more suitable.

**Rollers**

For sprayed sealing, self-propelled, multi wheel, pneumatic-tyred type rollers with an unballasted mass of 7 tonnes are used. These rollers have a smooth tread pattern tyre with operating tyre pressures about 600 kPa.

Drawn multi-wheel, pneumatic-tyred, rollers may be used but these have the disadvantage of poor manoeuvrability and care must be taken to avoid damaging the work when turning. Tractors used for towing these rollers should be fitted with tyres having a tread which will not damage the work.

Rollers should be fitted with coir mats suspended independently over each wheel to control distribution of water on the tyres and to prevent pickup particularly in the event of emulsion sealing.

**Drag Broom**

Some types of drag brooms used in sprayed sealing are:

- A lightweight frame, having diagonal lines of long flexible bristles and tow lines which may be attached to a truck or plant item.
  
  The pressure of the drag broom in the road surface is governed only by the mass of the drag broom.

- A broom mounted full width transversely across the rear of a pneumatic tyred roller.
  
  The controls for raising and lowering the broom are located in the cabin of the roller or mounted externally on the ends of the broom.

- A broom attached to the mouldboard of a light grader.
  
  The operator is able to vary the pressure and angle of the broom to the best advantage.

**Rotary Road Brooms**

The sweeping unit of a rotary road broom comprises a cylindrical broom from 0.5 to 1.0 m in diameter and 2.5 to 3 m in length which may be made up of individual small sections mounted on a driven axle or in one length on a specially constructed core.

The broom is suspended from a wheeled frame which is usually towed by a tractor or a truck. The broom is pivoted in the frame to allow it to turn in a horizontal plane up to 45 degrees on either side.

The broom is rotated by a drive from the road wheels, or by a motor on the broom or by the tractor hydraulics. A gear box may be provided to permit the broom to be rotated at different speeds to sweep varying conditions of the pavement.

The broom can be raised or lowered to vary the broom pressure on the pavement and to lift the broom clear of the road while travelling.

Some self-propelled brooms and three point linkage machine mounted brooms are also available.

**Vacuum Broom**

A vacuum broom removes loose aggregate from the pavement surface by suction only. It is a mobile self contained unit which consists of:

- A suction unit located close to the road surface.

- A closed hopper mounted on the back of the truck.

The hopper contains a water spray unit or filter bags to extract fine dust from the exhaust system.

Loose aggregate is removed by the suction unit which delivers the aggregate to the hopper. When the hopper is loaded with aggregate it may be discharged at the nearest dump site.

In dry conditions, dust nuisance is controlled by using the filter bag system located in the hopper. In wet conditions,
no dust is created during working and the filter bag system is by-passed.

**Plant for Slurry Sealing**

The most common plant used for slurry sealing is a truck mounted unit as illustrated in Figure A6.2 and consists of:

- bins for aggregate and filler.
- tanks for storing bitumen emulsion and water.
- a system for metering bitumen emulsion and water.
- mixing chamber.

Calibrated controls are provided for mixing the materials.

The truck tows a spreading box and is fitted with a spraying bar to allow pre-wetting of the pavement with water as necessary. The spreader box is equipped with mechanical devices to agitate and spread the slurry. Rut filling is carried out using a purpose built spreader box with a metal strike-off. The normal box has a rubber strike-off.

The truck is fitted with a guide arm and chain to enable the driver to follow the correct line.

**Blending Machine**

A blending machine is used to mix scrap rubber with bitumen as the bitumen is being transferred from the road tanker (or other storage unit) into the sprayer.

The blending machine consists of:

- a screw coupling onto which the inlet hose from the road tanker is connected.
- a rectangular trough conveying the bitumen from the inlet coupling to a spiral mixing chamber.
- a hopper located above the rectangular trough.

The hopper, which is used for feeding the scrap rubber into the blending machine, has a screen near the top to break up lumps of rubber, and screen out foreign matter.

At the bottom of the hopper are two serrated cylindrical steel drums which rotate in opposite directions so as to feed the scrap rubber down into the rectangular trough in a curtain of material of uniform width and thickness.

- The cylindrical mixing chamber at the downstream end of the rectangular trough mixes the scrap rubber and bitumen in an upward spiral motion.
- As the top of the mixing chamber is a screwed coupling to which is attached a hose feeding into the sprayer.

The blending machine is mounted on wheels and is usually transported between sites on a trailer.

The blending machine was developed by the Main Roads Department, Western Australia.
Figure A6.2  Plant for Slurry Sealing
Overhead emulsion storage tank

Photograph A6.4

Pontoons

Photograph A6.5

Bitumen sprayer

Photograph A6.6
Road suction cleaner
(Vacuum broom)

Photograph A6.7

Drag broom

Photograph A6.8

Rotary road broom

Photograph A6.9
Aggregate box spreader  
(Cockerell)

Photograph A6.10

Aggregate precoater  
(Delarue)

Photograph A6.11

Pneumatic tyred multiwheel roller

Photograph A6.12
Laying geotextile over a primed surface

Photograph A6.13

Aggregate Precocater in operation

Note: uneven precoating, poor stockpile and dusty aggregate

Photograph A6.14

Loading precoated aggregate into a spreader

Photograph A6.15
Incorporating scrap rubber into a bitumen sprayer

Photograph A6.16

Poor bitumen application due to blocked nozzles

Photograph A6.17

Steel roller used on sprayed seal (Note - aggregate breakdown under roller)

Photograph A6.18
DETERMINATION OF PERCENTAGE OF CUTTER OIL TO BE ADDED TO BITUMEN BINDER FOR SEALS AND RESEALS

When sealing and resealing cutter oil is added to the bitumen binder to temporarily reduce the viscosity, thereby improving the initial adhesion between the binder and the aggregate.

A minimum cutter oil content of 2% in bitumen is recommended for wetting.

The percentage of cutter oil to be added is determined immediately prior to spraying, using the following procedure.

Procedure

(a) Measure the pavement surface temperature.

If the pavement is partly in sun and partly in shade, the pavement surface temperature should be measured in both conditions.

As a short time will elapse between taking pavement temperatures and spraying the cutback bitumen, it is necessary to make an estimate of the pavement temperature at the time of spraying.

(b) Estimate the expected road temperature for:

. pavement in sun
. pavement in shade

(c) Assess the condition of the aggregate (Defined in RTA Form 382).

(d) Select the appropriate zone on the cutback chart in RTA Form 382 for the condition of the aggregate, using Note 2 on the chart.

(e) Select the appropriate portion of the zone on the cutback chart for the prevailing weather conditions, using Note 3 on the Chart.

(f) Select the appropriate percentage of cutter oil using the cutback chart, taking into account Note 4 if the pavement is partly in sun and partly in shade.

The percentage of cutter oil is expressed as the percentage of cutter oil in the mixture measured by volume at 150°C. For example, 15% cutter oil means that 15 parts of cutter oil are mixed with 85 parts of bitumen.

(g) Calculate the cold application rate of cutback bitumen mixture (at 150°C) with the selected percentage of cutter oil.

Example

If the cold bitumen application rate is 1.50 L/m² and the selected cutter oil content to be used is 8%, then;

Cutter Oil Application Rate (Cold)  
= \( \frac{8 \times 1.50}{92} \)  
= 0.13 L/m²

Application Rate of Mixture (Cold)  
= 1.50 + 0.13  
= 1.63 L/m²

Convert the cold application rate of mixture into a hot rate at the proposed spraying temperature.

Using the above example, if the proposed spraying temperature is 150°C and the cold application rate of mixture is 1.63 L/m², the hot spraying rate is calculated as follows:
From the volume correction table in RTA Form 23, the conversion factor (multiplier) to convert the volume of cold bitumen (@ 15°C) to an equivalent volume at 150°C is 1.0897, therefore:

Application Rate of Mixture (@ 150°C)

\[
\begin{align*}
&= 1.63 \times 1.0897 \\
&= 1.78 \text{ L/m}^2
\end{align*}
\]
APPENDIX A6.3

DETERMINATION OF APPLICATION RATE OF HOT BINDER

The designed application rate of binder as determined in Section 4 applies to binder at a temperature of 15°C.

As bituminous materials expand when heated, the application rates and volume of binder will be greater at spraying temperatures than the corresponding application rate and volume at 15°C.

Primes and Primerseals

The designed application rate of primer and primerbinder is calculated as follows.

Primer and Primerbinder

\[
\text{Application rate of hot primer or primer binder} = \frac{\text{Application rate of cold primer or primer binder at 15°C} \times \text{Multiplier from RTA Form 23 spraying temperature}}{100}
\]

Note: For spraying temperatures of primers and primerbinders, refer to Tables 6.7 and 6.10

Seals and Reseals

The designed binder application rates for seals and reseals apply to the residual binder which does not include additives such as cutter oil and adhesion agent.

The two steps in calculating the application rate of hot cutback binder are outlined below:

Seals and Reseals

(i) Determination of application rate of cold cutback bitumen.

\[
\text{Application rate of cold cutback binder} = \frac{\text{Application rate of cold residual binder} \times \frac{100}{100 - \% \text{ of cutter oil}}}{100}
\]

Note: For method of determination of percentage of cutter oil, refer to Appendix A6.2

(ii) Determination of application rate of hot cutback bitumen.

\[
\text{Application rate of hot cutback binder} = \frac{\text{Application rate of cold cutback binder} \times \text{Multiplier from RTA Form 23 spraying temperature}}{100}
\]

Note: For spraying temperatures of seals and reseals, refer to Table 6.11.
INCORPORATION OF SCRAP RUBBER IN BITUMEN

The incorporation of scrap rubber in bitumen is usually achieved by transferring bitumens from a road tanker to a sprayer via a blender which feeds scrap rubber into the bitumen line.

The procedure is:

1. Heat the bitumen (usually Class 170 bitumen) in the tanker (or storage unit) to a temperature between 190°C and 200°C.

2. Remove the strainers from the sprayer pipelines to prevent clogging of the strainers by lumps of scrap rubber.

3. Transfer 500 litres of bitumen from the tanker to the sprayer by opening the valve on the tanker and sucking with the sprayer pump.

Pumping rate should be adjusted such that the bitumen delivery line is about one third full.

4. Feed scrap rubber into the blender while continuing to pump bitumen from the tanker to the sprayer.

The quantity of scrap rubber to be fed into the sprayer is determined from RTA Form 394 - Scrap Rubber Bitumen Sprayer Loading Slip.

Scrap rubber should be fed at a steady rate so that the total quantity of scrap rubber has been added to the sprayer before the final 500L of bitumen has been transferred to the sprayer.

Care should be taken not to feed the scrap rubber so rapidly that the throat of the blender becomes choked. A suitable rate of feed would be 1 bag (35 kg) of scrap rubber for each 150L of bitumen.

5. Pump the rubber bitumen mixture into the sprayer tank at a location near the top of the tank.

6. Continually circulate the scrap rubber bitumen mixture in the sprayer tank during loading.

7. Transfer the final 500L of bitumen to the sprayer.

8. Circulate the scrap rubber bitumen mixture in the sprayer tank for a digestion period of 1 hour.

9. Heat the scrap rubber bitumen mixture to a temperature of 190°C to 200°C during the digestion period.

10. Take a sample of scrap rubber bitumen from the sprayer tank after the digestion period.

Forward the sample to the Materials Services Branch for determination of the elastic recovery of the binder.

11. Turn off the burners.

12. Add cutter oil and adhesion agent to the scrap rubber bitumen.

13. Circulate the scrap rubber bitumen in the sprayer for a further 15 minutes.

The scrap rubber bitumen is then ready for spraying.