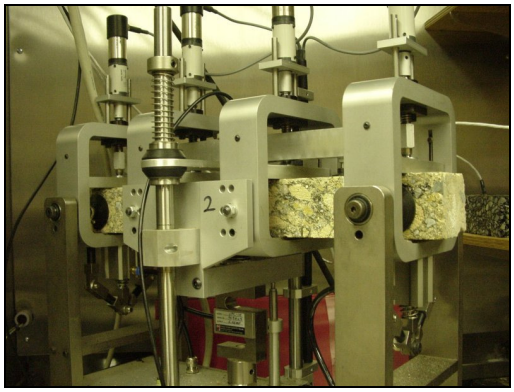

Model Specification for Plant-mix Stabilisation of Main Roads using Bituminous Binders

Version A2 – 2006

AUSTSTAB LIMITED

AustStab
Pavement Recycling and Stabilisation Association

Preface

The purpose of this specification is for the construction of new or existing main roads by plant-mix stabilisation with a bituminous binder, with or without a supplementary binder, such as cement, cement flue-dust, fly ash, slag or lime. Incorporation of the binder shall be accomplished using a purpose built stabilising plant. This specification is only applicable to foamed bitumen stabilisation.

A lack of design details, poor specification clauses, and poor construction practices by contractors with little knowledge of the process, quality control and materials may cause early distress of roads. Also, one of the problems faced by contractors during tendering is the variation of specifications. For example, in plant-mix stabilisation specifications are likely to change from one region to another region or State.

In attempt to minimise problems with road stabilisation AustStab has sought to produce a range of model specifications for use by State Road Authorities, Councils and Shires. A working group in AustStab was formed to prepare this model specification aimed at specifying plant-mix stabilisation of main roads for both urban and rural areas. It also gave consideration to practices adopted in all regions of Australia, such as the evaluation of lot size and density measurements for conformance assessment.

In the specification there are options to include and delete paragraphs and clauses based on the contractual requirements and practices by State Road Authorities in Australia. At the end of the specification is a schedule of rates that is required to be completed by the contractor in their submission to the tender documents.

The 11-page specification is available on a WORD2003 file and may be requested from the AustStab Internet web site at **www.auststab.com.au**. Amendments to the specification will be on the AustStab web site or you may telephone AustStab. If this document is read from Adobe Acrobat some reference documents are directly linked to the AustStab or other appropriate web site for easy reference. It is hoped that the model specification and commentary will be widely used and the Association looks forward to your feedback, such that further amendments will reflect best practice.

Greg White
Chief Executive Officer

Members of AustStab

Please refer to our website www.auststab.com.au

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AustStab Model Specification for Plant-Mix Stabilisation of Main Roads using Bituminous Binders

1 GENERAL

Foamed bitumen stabilisation is to be carried to a nominal *** m width and to a nominal finished depth of *** mm (refer typical cross section). The area to be treated is approximately *** m^2 and will be comprised of **********.

The proposed mass of bitumen content and supplementary binder is described in Annexure A, along with additional items that may be required to complete the project.

2 SCOPE OF WORKS

2.1 Overview

The work included under this contract comprises the supply of all materials, plant and labour necessary for the completed and proper construction of the proposed foamed bitumen stabilisation work in accordance with the design and specification requirements.

The stabilised pavement shall be composed of a combination of soil and binder uniformly and continuously mixed in the stationary plant-mix and compacted in accordance with this Specification and shaped to conform to the lines, grades, thicknesses and typical cross-sections shown on the plans, or as directed by the client's representative.

Stabilisation shall be undertaken by using the equipment described in this specification.

2.2 Works not included in contract

Works not included in the contract are:

- Traffic control
- Bituminous surfacing
- Treatment of unsuitable subgrade
- Pegging of the control line (by the client's representative)
- Offsetting the control line

3 REFERENCE DOCUMENTS

The standard specifications and test methods referred to are listed in Table 1, using abbreviated titles. Unless otherwise specified, the applicable issue of a reference document will be that current one week before the closing of tenders, or where no issue is current at that date, the most recent issue.

Table 1 Reference documents.

Binder	Australian Standard
Bitumen	AS 2008
GP & GB Cement	AS 3972
Lime	AS 1672
Determination of field density and field moisture content of a soil using a nuclear surface moisture – density gauge. Direct transmission mode.	AS 1289.5.8.1

4 MATERIALS

4.1 Binder

All binders shall be supplied by the contractor, shall comply with the Australian Standards as noted in Clause 3.

When required by the client's representative, the contractor shall furnish documentary or other acceptable evidence of the quality of the binder, and any binder that is not satisfactory shall be rejected**.**

4.2 Water

The water used for the work shall be supplied by the contractor and shall be potable. Where the water is drawn from natural sources, an efficient filter is to be provided on the suction pipe to ensure freedom from weeds, roots, etc., which could cause blockage of jets in the stationary plant-mix.

4.3 Granular Materials

[*Delete if not applicable*]

If additional granular pavement material is required to improve the existing pavement material, this material will be supplied by the client's representative and shall be homogeneously blended in the stationary plant-mix to the specified rate by the contractor.

4.4 Recycled Asphalt Profilings

[*Delete if not applicable*]

Reclaimed asphalt pavement (RAP) used as a supplementary pavement material shall be pulverised asphalt obtained from the profiling of asphalt pavements or by crushing to a uniformly graded material with a maximum particle size of 40 mm. Materials shall be free flowing and be capable of uniform blending and incorporation through the stationary plant-mix. If blended with suitable materials from the existing pavement, it shall be incorporated by the contractor at the rate and/or levels specified in the mix design and/or schedule of job details.

5 EQUIPMENT

The stationary plant-mix-mixing plant used in these Contract works shall satisfy the following minimum requirements:

- fully computerised control system associated with weigh-cells on the variable feed-rate for constituent materials, with read-out meters to allow continuous monitoring of bitumen, supplementary binder, foaming water and added moisture. This monitoring at the operation control station is recorded by percentage by weight of pavement material.
- minimum continuous production capacity of the plant shall be 100 tonnes per hour;
- an inspection or test jet must be fitted to ensure the flow of bitumen is constant and to enable the expansion and half-life qualities of the bitumen to be checked, and
- bitumen jets must be self-cleansing.

The contractor shall submit details of the proposed equipment and rehabilitation procedures to be used in the work, 14 days prior to commencement of the work. This submission, hereafter called the Work Plan, will nominate the sequence of operations, from initial production through final placement, compaction and trim. Submission of a Work Plan constitutes a **HOLD POINT**. The client's representative inspection of the Work Plan and approval is required to release the hold point.

Notwithstanding submission to the client's representative of the Contractor's equipment and rehabilitation procedures, the work shall meet all the Specification requirements herein, and relevant Statutory requirements for environmental protection, and occupational health and safety.

6 CONSTRUCTION PROCESS

6.1 Lowering of Services

The client's representative will lower all services and utilities as necessary.

6.2 Initial Surface Preparation and Milling

[*Delete if not applicable*]

Where overlaying the existing pavement, the surface of the existing wearing course shall be lightly scarified or pre-milled (and suitably broomed/cleaned), to provide suitable bonding with the newly placed layer.

6.3 Climatic Restraints

Stabilisation (including plant-mix operations, compacting and finishing) shall not be carried out when the temperature measured in raw material stockpiles is below 10^0 C.

Stabilisation (including plant-mix operations, compacting and finishing) shall not proceed

(a) during rain, or
(b) during conditions that may cause nuisance or danger to people, property or the environment.

Details of procedures for ceasing operations in the event of rain or other climactic conditions shall be submitted as part of the QUALITY PLAN.

6.4 Application of Binder

6.4.1 Bituminous Binder

The binder shall be uniformly incorporated by a controlled device that provides calibration to the application rate of bitumen. The minimum expansion rate shall be 10 and the minimum half-life shall be 20 seconds.

Mixing uniformity shall be continuously inspected visually by the contractor and work shall stop when bitumen streaks or blotches are observed. The construction tolerance for the application rate is ±10%.

Application rate checks/reconciliation measured in kilograms per tonne of product shall be monitored and recorded for every 100 tonnes of production, via the onboard weigh-cell computerised accumulator system.

Regular calibration of all weigh cells within the plant shall be undertaken and recorded, in line with the manufacturer's published guidelines.

The inspection nozzle shall be used to verify the foaming characteristics at the start of every bitumen tanker load. These records shall be kept for at least 12 months after completion of the project.

6.4.2 Supplementary Binders

Supplementary binders shall be uniformly incorporated with calibrated electronic load cells. The contractor shall record the tonnage of binder used per production shift and keep these records for at least 12-months after completion of the project. The construction tolerance for the application rate is ±10% of the specified value (refer to Annexure A).

When hydrated lime is specified as the supplementary binder, the application rate used by the contractors shall be the specified value in Annexure A adjusted to the Available Lime Index.

6.5 Mixing

The stationary plant-mix shall be purpose built for the process of mixing road-making materials, and shall be maintained and calibrated so as to provide a uniformly mixed product without segregation of the aggregate material (also refer to Clause 5).

The plant shall also provide for the controlled and metered addition of water into the mix, as required for subsequent placement and compaction.

The materials will generally be produced to the target moisture content as nominated in Annexure A (expressed as a % relative to the optimum moisture content "OMC" of the materials), or as otherwise approved by the Client's representative.

The total fluid content of the material immediately after mixing shall be 80% to 100% of the target moisture content specified by the Client's representative.

Water shall only be applied through the mixing chamber of the stationary plant-mix to meet the moisture content unless a pre-moisturing and mixing process is carried out.

6.6 Placing of Pavement Materials

The material produced from the stationary plant-mix shall be transferred and spread in one concurrent operation, and after compaction, the finished surface levels on the base (and/or subbase) courses shall be within the permitted tolerances without subsequent addition of material.

The thickness of each compacted layer shall be neither less than 100 mm nor more than 300 mm, unless otherwise approved by the Superintendent.

The mix is to be placed without visual signs of any significant segregation, and any such areas are to be removed and replaced with fresh mix.

6.7 Joints

Joints are defined in this specification to comprise interfaces between work episodes and a longitudinal joint shall be considered to be a joint generally parallel to the road centreline. A transverse joint occurs when a length of work is terminated at the end of any working shift and extended at a later time.

All longitudinal and transverse joints shall be formed by cutting back into the previously placed and fully compact sections. A minimum longitudinal overlap of adjacent runs shall be 75 mm, and transverse joints shall be overlapped by a minimum of 0.5 metres. The material disturbed during cutting back may be incorporated again into the new work.

No longitudinal joints shall be allowed within 500 mm of the centreline of a typical wheelpath, and where asphalt surfacing is to be the final surface, construction joints between the surface and the plant-mixed materials, are to be separated by at least 100 mm.

6.8 Compaction

The foamed bitumen layer(s) shall be compacted over the entire area and depth so that the relative compaction requirements as outlined in Clause 8.4.

6.9 Finishing

The finished surfaces shall be true to line and level, with correct crossfall, and free from loose pockets, holes, bumps and flakes of material.

[*Delete next paragraph if not applicable*]

The finished surface shall be as specified and to within ±10 mm.

[*OR*]

The pavement surface is to be finished to a straight uniform profile from the crown of pavement to the lip of gutter with full width stabilisation.

Where shoulders only are to be stabilised, the finished profile shall comprise a straight uniform crossfall from the edge of the existing pavement to the outer edge of the construction.

All final trimming shall be cut to waste or reused in other applications as directed by the client's representative.

6.10 Curing

The compacted and trimmed surface may be opened to traffic before the next pavement layer or wearing surface layer is constructed.

The constructed base shall be protected against drying out by keeping it damp during the period prior to provision of the wearing surface layer. The maximum period until surfacing shall be applied will vary dependent on specific traffic and project conditions, and should be agreed between the client's representative and contractor before work commences.

The contractor shall submit details of the proposed equipment and rehabilitation procedures to be used in the work, 14 days prior to commencement of the work. This submission, hereafter called the Work Plan, will nominate the sequence of operations, from initial production through final placement, compaction and trim. Submission of a Work Plan constitutes a **HOLD POINT**. The client's representative inspection of the Work Plan and approval is required to release the hold point.

6.11 Stockpiling stabilised material

Foamed stabilised material may be stockpiled for up to 28 days provided protective covers are used over the stockpiles and all stockpiles are identified.

The stockpile height shall not exceed 4 m and be located on a stabilised clean base, well drained and meet all regional environmental regulations.

Should moisture loss occur during stockpiling, water shall be introduced into the material by mixing the material in the pug-mill.

Removal of material from the stockpile shall be carried out to minimise segregation.

7 PRELIMINARY TRIAL

If directed by the client's representative, the contractor shall carry out a preliminary trial of the proposed stabilising operation. This trial constitutes a **HOLD POINT**. The client's representative inspection of the Work Plan and approval is required to release the hold point.

The trial shall determine:

a) the effectiveness of the construction plant;
b) the field moisture content required to achieve specified compaction requirements;
c) the rolling routine required to meet specified compaction requirements.

The trial section shall be located within the Works area.

The length of the trial section shall be between 50 and 100 metres of the proposed width to be stabilised.

8 ACCEPTANCE CRITERIA

8.1 Lot determination

Compaction is to be accepted by density testing in lots of similar material and work. Unless otherwise specified, the maximum lot size shall be the area of work completed on the same day up to 2,500 m^2 provided that the whole of the lot is essentially a uniform material similar to material used for the relevant mix design applicable to the lot.

The calculation of density ratio shall be based on Standard compactive effort of the laboratory prepared sample containing the design rate of cementitious binder.

[*Insert specific regional conditions regarding lot compliance to density measurements*.]

8.2 Application and spread rate

The bitumen application rate shall be verified through dipping of the tanker at the start and finish of the production shift. The contractor shall verify the application rate for supplementary binders as per AustStab National Guideline or as directed by the client's representative.

The construction tolerances on the application rate of the foamed bitumen is ± 10% of nominated rate and supplementary binder is ± 10% of nominated spread rate.

Table 2 Deductions for bitumen application or supplementary binder rate.

Relative rate of measured to specified	Per cent deduction applied to Pay Item P1 or P2 and P6 + P7
85 – 89 %	20
80 – 84 %	40
75 – 79 %	60
≤ 74 %	Lot to be rejected

8.3 Depth

The depth of foamed bitumen layer(s) shall be verified by measuring from the base of the placed material to top of finished surface measured to the nearest 5 mm. The construction tolerance for the stabilised and compacted depth is ±20 mm.

8.4 Density

[*Insert specific regional conditions regarding lot compliance to density measurements*.]

8.5 Surface Profile

After final trimming the construction tolerance on the finished pavement level shall not vary by more than 10 mm in any direction when tested with a 3 m straight edge. In addition, the crossfall shall not differ by more than ± 5% of the nominated rate.

8.7 Ride Quality

For sections where the ride quality is less than or equal to 49 counts per kilometre for 100m lengths, an incentive payment in accordance with Table 3, shall be applied.

For those 100 m lengths where the ride quality is non-conforming, deductions, in accordance with Table 3 shall be applied.

The incentives and deductions apply to the lane width for the lane measured.

Table 3 Incentives and deductions for ride quality.

Roughness Count/Kilometre over 100 metre length	Incentives/Deductions (per cent of Pay Item P7)
< 25	+ 3%
25 – 34	+ 2%
35 – 39	+ 1%
40 – 49	Nil
50 – 54	- 2%
55 – 59	- 4%
60 – 64	- .8%
65 - 69	- 16%
≥ 70	Reject

9 MINIMUM TESTING FREQUENCY

The Contractor shall test the materials and the stabilised pavement layer at a frequency which is sufficient to ensure that the materials and work under the Contract comply with the specified requirements but which is not less than that shown in Table 4.

Table 4 The minimum frequency of testing.

Test	Minimum frequency of testing
Uniformity of bitumen application rate	One test for at least continuous production run or 100 tonnes of pavement material. The Contractor shall have a current certificate of calibration for the bitumen tanker and shall produce evidence of the actual running bitumen application rate when requested by the client's representative.
Uniformity of spreading of supplementary binder	As per for bitumen.
Density ratio	Every lot as defined in Section 8.1

10 REWORKING

During the construction process or within 7 days afterwards, reworking can be carried out if compaction and finishing does not meet the initial requirements set in this specification. After this period and should the remedial work not meet the requirements of the specification for compaction, the contractor shall present a design solution for the design traffic specified by the client's representative.

Where restabilisation is proposed, the contractor shall:

(a) arrange, through an appropriately NATA registered laboratory, a restabilisation proposal which takes into account the effects of the bitumen and stabilising binder already incorporated in the rejected layer, and
(b) submit to the client's representative details of the restabilisation proposal.

Where an alternative to restabilisation is proposed the contractor shall supply:

(a) design documents including pavement design calculations
(b) test certificates and a report relating to the laboratory investigations, and
(c) details covering the method of carrying out the proposed work.

Where material is nominated to be removed and replaced, all conditions of this specification shall apply.

Where a Lot is rejected because of roughness the contractor shall nominate a proposed rectification.

All costs associated with restabilisation, submission of an alternative design or rectification shall be borne by the contractor.

11 MEASUREMENT & PAYMENT

11.1 Pay Items

Payment for the activities associated with completing the work detailed under this Specification shall be made in accordance with Pay Items P1 to P10.

Where stabilised material is rejected because of its failure to meet the requirements of this specification, all costs for restabilising, redesign or rectification together with any extra costs incurred by the contractor in respect of delays caused by such work, shall be borne by the contractor.

11.2 Pay Item P1 – Site Establishment

This is a fee covering the supply to the site, set-up and removal and make good the stationary plant-mix equipment and temporary offices to complete the work in the contract.

11.3 Pay Item P2 - Supply bitumen and additives

The unit of measurement shall be the tonnes.

The quantity shall be determined by multiplying the specified width of stabilisation by the length executed by the application rate. Additional areas (eg parking areas, slip lanes etc) directed to be stabilised shall be included when calculating the total area treated.

No account shall be made of the tolerances allowed in the application rate, or for areas applied outside the area directed for treatment.

This Pay Item shall include all costs associated with supply of the bitumen and additives to achieve the desired bitumen foaming characteristics to achieve density and strength of the pavement material.

11.4 Pay Item P3 – Supply and deliver supplementary binder

The unit of measurement shall be the tonnes.

The quantity shall be determined by multiplying the specified width of stabilisation by the length executed by the spread rate. Additional areas (eg parking areas, slip lanes etc) directed to be stabilised shall be included when calculating the total area treated.

No account shall be made of the tolerances allowed in the spread rate, or for areas applied outside the area directed for treatment.

This Pay Item shall include all costs associated with supply to site of the supplementary binder.

11.5 Pay Item P4 - Supply & deliver additional granular material

The unit of measurement shall be the tonnes.

The quantity shall be determined by multiplying the specified width of stabilisation by the length executed by the unit mass and depth of layer or by delivery docket. Additional areas (eg parking areas, slip lanes etc) directed to be stabilised shall be included when calculating the total area treated.

This Pay Item shall include all costs associated with supply to site of the additional granular material.

11.6 Pay Item P5- Supply RAP material

The unit of measurement shall be to the nearest tonne.

The quantity shall be determined by multiplying the specified width of stabilisation by the length executed by the unit mass and depth of layer or by delivery docket. Additional areas (eg parking areas, slip lanes etc) directed to be stabilised shall be included when calculating the total area treated.

This Pay Item shall include all costs associated with supply to site of the recycled asphalt profilings (RAP).

11.7 Pay Item P6 – Mix pavement material, bitumen, supplementary binder, and water

The unit measurement shall be tonnes.

The costs for this pay item is associated with incorporation of the bitumen and supplementary binder to the required pavement material using a purpose built stationary plant-mix for foamed bitumen stabilisation.

11.8 Pay Item P7 – Place, compact and trimming

The unit measurement shall be m^2.

The costs for this pay item is associated with the placement of foamed bitumen material, compaction and trimming of the stabilised material to the specified levels of density.

11.9 Pay Item P8 – Density testing

The unit measurement shall be m^2.

The costs associated with this pay item is the extraction of samples, deliver and laboratory testing, and reporting of results.

11.10 Pay Item P9 – Rise and fall cost for bitumen

Should the cost of the supply of bitumen vary from the tender date and the project timing, the contractor shall submit rise or fall documentation from the bitumen supplier. The unit measurement shall be tonnes.

11.11 Pay Item P10 – Ride quality testing

The unit measurement shall be m^2.

The costs associated with this pay item is the use of calibrated devices to measure ride quality and report results.

11.12 Summary of Pay Items

The contractor shall complete the following table during the tender submission.

Summary of pay items

Pay Item	Description	Unit	Measure-ment	Rate or cost ($)
	[*Delete not applicable rates*]			
P1	Site establishment	No.	-	
P2	Supply bitumen and additives	t		
P3	Supply and deliver supplementary binder	t		
P4	Supply additional granular material	t		
P5	Supply RAP material	t		
P6	Mix pavement material, bitumen, supplementary binder, and water	t		
P7	Place, compact and trimming	m^2		
P8	Density testing	m^2		
P9	Rise and fall cost for bitumen		-	
P10	Ride quality testing	m^2		

All rates are exclusive of GST.

Annexure A: Contract Project & Pavement Mix Design Parameters Summary

Nominated bitumen to be used	Description
Nominal percentage of bituminous binder by mass:	X %
Nominated supplementary binder to be used	Description
Nominal percentage of supplementary binder (……) by mass	X %
Nominated target moisture content	X %
Nominated additional granular material to be used	Description
Nominated additional granular material to be used	tonnes
Nominated RAP material to be used	Description
Nominated RAP material to be used	tonnes
Depth of compacted layer(s) to be constructed:	As shown on Project Drawings
Base	X mm
Subbase (if applicable)	X mm
Maximum period between completion of pavement base and application of surfacing :	X days

Commentary to AustStab's Model Specification for Plant-Mix Stabilisation of Main Roads using Bituminous Binders

Introduction

The purpose of this commentary is to provide a background to the clauses in the model Specification to assist the specifier in completing the document ready for tendering. The model specification was prepared by the members of AustStab and provides best practice. This commentary makes reference to various **AustStab National Guidelines** and amendments to the specification or guidelines, will be available through AustStab members, listed in *AustStab News*, or on the AustStab web site at **www.auststab.com.au**

The Specification has been written so that it can only be applied for foamed bitumen stabilisation of plant-mixed materials, and the format of this commentary follows the same number and title sequence as the Specification.

The aim of this specification is for State Road Authorities to specify the same construction principles around Australia and the specification may be used for new or existing roads.

The State Road Authority representative for the work is described as the client's representative in this document. Other terms used in this document are defined in the AustStab National Guidelines and Technical Notes.

This specification is applicable for base and subbase pavement layers, and a range of project sizes, including individual patches 20 m^2 size. However, the roughness criteria should be based on a minimum continuous run of 1,000 m over the full width of the pavement including shoulders.

1 GENERAL

General Process Description

The process of foaming bitumen is where hot bitumen (about 180°C) comes into contact with cold water in precise quantities to create a bitumen foam.

The reduced viscosity and surface tension of foamed bitumen enables it to be uniformly dispersed and mixed through the pavement material whilst in this state. Most bitumen products have anti-foaming agents and therefore, additives are commonly used with the bitumen to allow the foaming process to take place.

The purpose built foamed bitumen mixing plant is shown in **Figure 1**, and incorporates a special foamed bitumen spray bar and paddles designed to thoroughly mix the material and foamed bitumen binder within the mixer. The foamed bitumen needs to be added to the material as it enters the mixing chamber to enable adequate mixing through the chamber due to the limited time (half-life) of foamed bitumen to disperse through and coat the materials finer particles (see **Figure 2**). Also, refer to the minimum requirements in section 5 of the commentary.

Typically pugmill-plant road stabilisation involves use of specialised equipment brought to a site near the works and the existing pavement materials are milled, stabilised and replaced, similar to that used in asphalt rehabilitation.

Figure 1 *View of purpose built foamed bitumen plant-mix in use.*

Profilers or milling machines can damage services when in operation, and thus the client's representative should identify any services to be lowered before works commence. Any extra time required, should then also be considered within the engineer's program of works. These milling machines also have the ability to remove existing asphalt and cemented layers to depths up to 300 mm, and then incorporate the material in the stabilised mix. In fact, the existing asphalt typically contains the best quality aggregates in the pavement structure, and thus can often enhance the strength of the new/recycled layer. Some care should be taken however, during pulverising, stockpiling, and subsequent mixing operations, to minimise segregation and ensure efficient mixing of these materials.

In Australia, foamed bitumen stabilisation is usually used in conjunction with a supplementary binder, typically lime, to enhance adhesion of the bitumen to

the aggregates, and in some cases to improve the PI or short-term trafficking properties of the material. This specification assumes that the use of supplementary binders, is in the low binder range (ie. not > 2% by weight of the pavement material). For more information refer to reference 1).

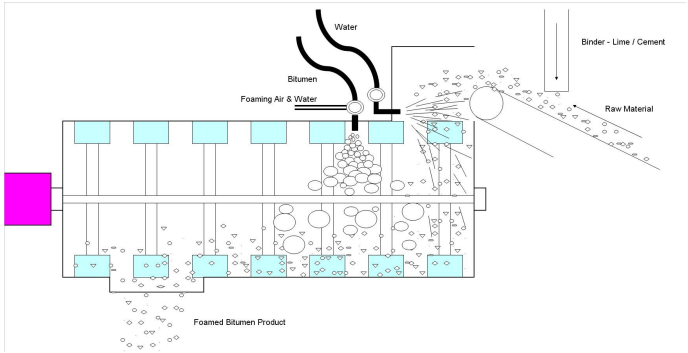

Figure 2 *Material flow through the pugmill, showing the incorporation of foamed bitumen via the spray-bar.*

2 SCOPE OF WORKS

The specification allows for part and full-service contracts. A full service contract is defined as where the contractor supplies all materials and equipment, to mix and produce materials, and subsequently compact, trim and cure the new/recycled pavement. Part service works may typically involve only the production of foamed bitumen strengthened materials, with final placing, compact and trim being done by the client. Some parts of the Specification would obviously then be appropriately deleted for part-service works.

Where works include the placing, spreading, compaction and trimming of the foamed bitumen material the following areas may need to be considered;

(a) Final levels to be achieved after re-construction process:

(i) where levels are to be increased, suitable extra granular/RAP materials can be imported to the mixing site, and blended in to supplement the existing materials to meet new road levels/profile.

(ii) where levels are to be reduced, extra depth may be profiled or excavated from the pavement, and any unsuitable materials taken from the road site.

(b) Water can also be added during the pugmill or placing operations, to adjust the pavement material moisture content ready for compaction (typically to ~ 70 to 90% of OMC, dependent on conditions).

(c) Traffic control

(d) Treatment of soft or unsuitable subgrade

(e) Surveying / control of finished levels.

(f) Bituminous surfacing may consist of a sprayed seal wearing course or asphalt.

3 REFERENCE DOCUMENTS

Each State Road Authority has various test methods and Australian Standards for the evaluation of binders and the stabilised material. The specification only lists the essential binder Standards and each State Road Authority should include in this section those specific regional test methods and other specifications required for the project.

4 MATERIALS

4.1 Binder

All bitumen and supplementary binders used for road stabilisation should comply with an Australian Standard as noted in the specification. However, they should be as proven in laboratory trials. More information on binders may be sought from references 2 and 3.

4.2 Water

The water used for stabilisation should be potable. The characteristics of the water should soft, reasonably clean, and free from oil, acid, alkali, organic or other impurities. In addition, the amount of water and binder should be established by laboratory testing. Sea water should not be used for bituminous stabilisation.

4.3 Granular Materials

In many roads the granular pavement material is either crushed rock from an established quarry or recycled asphalt pavement (RAP) material. The grading requirements for these materials are based on the suitability of the existing pavement material, and blended with other suitable materials.

4.4 Recycled Asphalt Profiling (RAP)

It is common to use the existing seal or asphalt in foamed bitumen stabilisation. Whist the original bitumen from the profiled materials will vary, the contribution to total new bitumen content added during stabilisation will typically be minor, and it should not reduce the stiffness of the stabilised material.

In any project where significant amounts (ie >10%) of RAP material is being used relative to the existing pavement materials, the RAP material should be added (in the relevant proportions) in laboratory samples.

5 EQUIPMENT

Specialist equipment is required for foamed bitumen plant stabilisation, as the foaming process only allows one opportunity for accurate application of the foamed bitumen binder to the pavement materials.

Minimum requirements are noted in the specification as:

- fully computerised control system associated with weigh cells on the variable feed-rate for constituent materials, with read-out meters to allow continuous monitoring of all ingredients ;
- minimum continuous production capacity of the plant should be 150 tonnes per hour (to assist accuracy of weighing & application of binders) ;
- an inspection or test jet must be fitted to ensure the flow of bitumen, and that the required expansion and half life qualities of the bitumen are being achieved (see as per **Figure 3**) ; and
- bitumen jets must be self cleansing.

Figure 3 *Operator assessing the foaming of bitumen from special inspection nozzle system on the plant.*

Whilst these are the minimum requirements, other required equipment features include;

- easily read bitumen temperature gauges and application rate gauges and settings ;
- the correct coupling fittings for bitumen lines to allow ease of loading, and avoid spillage/leaks ;
- fire extinguishers appropriately mounted on the pugmill-plant for ease of usage (see in **Figure 4**).

In addition, well-trained plant operators are required to ensure that the foaming operations are working during the process.

Figure 4 *View of two 9 kg fire extinguishers mounted on the plant for ease of access & use.*

6 CONSTRUCTION PROCESS

6.1 Lowering of Services

Experience with many projects has indicated that the client is usually in a better position to organise and/or to carry out the work to lower all services and utilities as necessary (although some Contractors will arrange). The lowering of services should meet the guidelines set by utility companies and they should be carried out such that there is sufficient cover for brittle pipe work.

The lowering of services should be programmed into the works schedules, such that onsite delays are minimised.

6.2 Initial Surface Preparation and Milling

The pavement materials are milled out and transported to the mix site. The depth of milling is determined by the required pavement depth including wearing course and taking into account any variation from existing levels to finished design levels.

A failure of the subgrade is not always apparent with a visual inspection and it is suggested, that the exposed surface be given proof-rolling to reveal any irregularities. Should a weak area of subgrade be identified from proof rolling, strengthening should be undertaken to increase the subgrade support for greater traffic life and aid in the compacting of the subbase and base pavement layers. The responsibility for this subgrade strengthening should be clearly stated in the tender documents, and would normally be done on a ‘provisional item’ basis.

Thick-layers of existing asphalt patching within the area of road rehabilitation, can be effectively pulverised

with due care whilst profiling. They can be blended with the pavement materials for mixing.

6.3 Climatic Restraints

The foamed bitumen stabilisation process can operate in low and high temperatures. However, it is suggested that stabilisation mixing does not commence until the pavement temperature at 50 mm below the stockpile is at least 10°C. Covers on the stockpile may be necessary to sometimes achieve this in winter operations.

In terms of wet weather, safety of staff and road users is the overriding factor to decide when stabilisation should commence or be halted due to rain. Once foamed bitumen has been incorporated into the materials, they are unlikely to take in or retain significant moisture during wet weather, and typically if the underlying layer (ie subgrade) has not been unduly affected by weather, works can typically be commenced immediately after the rain shower has ceased.

6.4 Interruption of Works

Due to the long-term curing characteristics of foamed bitumen, the pavement material may be remixed without the addition of bitumen or supplementary binder for some weeks. However, a conservative approach would be to limit this to 7 days (also refer to Section 10), after which further laboratory testing is advised.

6.5 Mixing

It has been noted previously that incorporation of the bitumen for foamed bitumen techniques can only be carried out by the use of specially manufactured spray bars located in the pugmill mixer (see Figure 2).

For bitumen and lime binders, the application rate is expressed as a % by mass of the pavement material. The plant should allow for easy setting, adjustment and monitoring of the bitumen and supplementary binder rates from the operator control panel.

The application rate should be determined prior to the commencement of the works through laboratory or field trials, using samples representative of actual materials to be used in the works. When determining the actual application rates in the field, allowance should be made for the moisture in the materials.

Typically the contractor has computer-controlled devices on board the foamed bitumen plant that calculate the application rates of the binders as the material moves into the pugmill.

Regular calibration of the plant by weigh scales should be undertaken to ensure correct calculation and addition of binders. Each plant will be different in this regard and manufacturers guidelines should be followed. In addition dipping in the bitumen tanker before and after a production run can confirm the computer-collected data or reconciliation of delivered quantities against the produced quantities.

For foamed bitumen operations, two key parameters are specified in clause 6.5.1 of the Specification.
The *expansion ratio* is defined as the ratio of the maximum volume of the bitumen in its foamed state to the volume of bitumen once the foaming has completely subsided. In foamed bitumen stabilisation for roads, a suggested minimum expansion ratio of **10** is specified.

The other term used in foamed bitumen stabilisation is *half-life,* and this is defined as the time taken (measured in seconds) for the foamed bitumen to settle to one half of the maximum expansion volume. Experience has shown that the half-life measured in the field and laboratory differ greatly and the engineer should monitor half-life in the field. For more information refer to Reference 1.

Both of these parameters are important to foamed bitumen stabilisation to ensure that during the mixing operation there is sufficient time to coat the pavement particles in the mixing chamber. Too short a half-life and insufficient bitumen coating of the particles will typically lead to lower strength.

Uniform mixing of the binder is paramount to the success of the stabilised pavement, and therefore, it has been previously noted that specialised machines should only be used in this process.

All AustStab contractors work to a well planned and proven procedure based on their quality manuals. Unfortunately, wet weather conditions, plant breakdown or other causes may prevent the binder from being uniformly incorporated into the pavement in accordance with the above procedure. With the use of bitumen it has been found that the material can be reworked for at least 7-days after initial mixing.

6.6 Placing of Pavement Materials

The moisture content of the material immediately after mixing is set at a range of 80% to 110% of the moisture content specified by the client's representative. An experienced contractor should be able to monitor the moisture content during production, by moulding and squeezing sample materials from the finished stockpile. Suitable moisture control would also be verified before removing from the stockpiles in the material was manufactured the day before.

Operators should monitor the production of material regularly, and make necessary adjustments as required.

Similarly, during placing and compaction operations and any surface moisture loss can be replaced with the use of water cart sprays as required.

6.7 Joints

The excavation of material generally proceeds in lanes working from one side of the pavement to the other. When placing material using a grader the entire excavated lane width should be replaced and compacted together. Where this is not possible, an area of 300 mm should be left to be compacted with the subsequent lane materials, when placed later that shift.

When excavating areas adjacent to previously stabilised areas a joint must be cut back into the previously stabilised and compacted work. The material disturbed during cutting back is removed. The minimum distances of cutback into previously stabilised material is typically:

(a) longitudinal joints - 75 mm
(b) transverse joints - 0.5 metres.

The contractor sets a layout of all joints based on the following requirements:

(a) Minimise the number of joints to be formed.
(b) Longitudinal joints should be offset by at least 300 mm from design location of wheel paths
(c) Transverse joints are formed at right angles to the road centreline.
(d) Longitudinal joints are formed on the separation lines of the travel lanes and a minimum of 300 mm outside the edge lines in the shoulder area.
(e) Internal longitudinal joints are formed such that each is at a constant offset to the road centreline.

Additional information on joint techniques may be found in Pavement Work Tips No.4.

6.8 Compaction

Generally foamed bitumen materials require less compactive effort to achieve a similar level of compaction than a granular pavement, due to the increased “lubrication” provided by the bitumen. Hence, compaction can be carried out in one layer for pavement depths of up to 300 mm.

Compaction of the material in the pavement is best carried out immediately so that final trimming can be achieved. The slower setting characteristics using foamed bitumen binders allows more flexibility with compaction times. In colder climates, a “cool” material may slow the setting, although this can be offset somewhat by the use of the supplementary binder. Specific project circumstances should be taken into consideration at the design stage of works.

The minimum compaction is set at 98% (standard) of the maximum dry density, which can allow a greater scope in the successful use of marginal materials. With better parent materials, a higher minimum compaction should be achieved by the contractor.

Selecting the right compaction equipment, suitable to the project circumstances (eg. vibration sensitivity, etc), is typically carried out by the stabilisation contractor.

6.9 Finishing

Two options are provided in this section of the specification, namely to trim to a specified level below the existing kerb and gutter profiles or to a specified crown with cross fall, such as in a rural areas.

6.10 Curing

Curing of a bituminous stabilised pavement occurs very slowly and studies have shown that the maximum stiffness may be reached in about 1 year. However, foamed bitumen stabilised materials would normally gain sufficient strength to allow immediate trafficability upon completion of compaction and trimming.

6.11 Stockpiling stabilised material

Local and overseas experience has shown that foamed bitumen materials may be stockpiled provided the construction of stockpiles minimises the potential for segregation of the fines from the coarse aggregate and moisture control is contained. However, if moisture loss occurs the best approach is to mix water into the material with the use of the pug-mill. It is considered poor practice to wet the stockpile with a hose and mix the material using a front-end loader or to spray water on the surface of the loose material before compaction at the road site.

7 PRELIMINARY TRIAL

Similar to insitu stabilisation, a trial production run can be undertaken for foamed bitumen plant works, to confirm specified requirements of the mixing process with the specified binders and proposed pavement materials.

A trial run may consist of the first day’s work or the first 100 t of material. In addition, the trial allows the contractor to ensure that the bitumen and supplementary binder application rates are producing material that is workable, easily compacted and consistent with the contractors and clients expectations. If a trial is carried out in the morning the contractor has only until midday to order materials for the next day’s production. Therefore, the timing of the collection of data and its assessment is paramount to reduce the

number of days the expensive equipment is held waiting on site.

8 ACCEPTANCE CRITERIA

8.1 Lot Determination

The definition of a lot varies from State to State and this clause is typically tied into the requirements of density.

The maximum lot size is either the daily production or constructed pavement, utilising the same pavement materials and target mix design. A typically daily production may be 1,500 tonnes or 1,500 m^2 of completed pavement.

8.2 Application rate

The specification requires the contractor to regularly check the bitumen application and supplementary binder rates. The plant should have readouts to show the consumption of all products. The normal tolerance is the practical equipment limitation of ± 10%.

8.3 Depth

The depth of the stabilised layer can only be checked after compaction and final trimming. Experienced contractors have specific methods to achieve the specified depth and allow for the bulking and trimming thickness.

8.4 Density

Density of the stabilisation material is very important to its performance. In order to meet the required density the use of suitable rollers and good compaction practices is recommended [Ref.6].

Each State Road Authority has a specific method for density measurements based on either individual lot measurements or a rolling mean system to accommodate the fluctuating tolerances in the process. Therefore, this specification requires the lot density testing requirements to be inserted based on the client's QA system.

8.5 Surface Profile

As in ride quality, this measure is sometimes dependant of factors outside the control of the contractor. The limits form a guide to what should be achievable in various project conditions.

8.6 Ride Quality

Ride quality limits are included to achieve the desired smoothness. It is noted that the following impediments to ride quality are out of the control of the contractor:

- ☐ in half-road width paving the crown dictates the longitudinal shape of the pavement and hence, the contractor is limited in his outcomes (this is also applicable for existing shoulders),
- ☐ for pavements under traffic the grader operator has limited space to adjust the angle of attack of the blade, and this limits the quality of his work in the confined space, and
- ☐ level control can conflict with roughness.

In the latter case, level control is established after primary trimming, and roughness measurements made after final compaction and trimming, and before the seal is on the pavement. The latter issue is important as the sealing of the pavement can be several days after final trimming, and subsequent rain and traffic on the pavement will affect the roughness measurement.

The best ride quality will be achieved through the use of a paver and stringlines.

8.7 Other Tests

Whilst not included in the specification, in some instances the client may wish to take samples from the produced stockpile or placed material before compaction and compact those samples using Marshall or Gyropac devices. After 3days of accelerated curing the wet and dry resilient modulus of the samples can be determined and assessed for each lot.

Taking these additional tests is at the clients expense and can relieve any uncertainties, and may avoid costly field testing and road closures during the first 1 to 2 years of the trafficked pavement.

9 MINIMUM TESTING FREQUENCY

The specification sets out minimum regular testing requirements for:

- ☐ Bitumen application rate
- ☐ Supplementary binder application rate
- ☐ Density ratio

10 REWORKING

Unlike cementitious binders that form chemical bonds within the first 24 hours of mixing, foamed bitumen stabilisation with lime allows the contractor to rework the pavement material for up to 7 days after initial

compaction, without compromising final density achievement and material stiffness.

11 MEASUREMENT AND PAYMENT

The pay items have been based on specific tasks in the stabilisation process and notes as:

P1 – Site Establishment
P2 – Supply bitumen and additives.
P3 – Supply and deliver supplementary binder
P4 - Supply and deliver additional granular material
P5 - Supply RAP material
P6 – Produce foamed bitumen pavement materials
P7 – Place, compact and trimming
P8 – Density testing
P9 – Rise and fall cost for bitumen
P10 – Ride quality testing

Item P9 allows for the sometimes volatile changing oil prices to be provided for, as the quoted bitumen supply cost at tendering, and the cost when purchased for the project, may vary significantly dependent on the time for project award and completion. This clause will hopefully allow tenderers to provide their most competitive price at the time of tendering, rather than err on the conservative side as a precaution that may not be needed, and jeopardise their opportunity to win the project.

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NOTES: