



TECHNICAL BULLETIN #18

SAM 'C' Polymer Concentrate for SAM's and SAMI's

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DESCRIPTION

Stress Absorbing Membrane (SAM) used for Spray Seals

The modification of bitumen with rubber provides a binder with a combination of improved characteristics not possible with bitumen itself. It provides a significant increase in softening point which reduces tendency to flushing and bleeding and such as would normally only be found with a 10 or 20 Pen bitumen. At the same time, the ductility is higher than can be obtained with a very soft bitumen such as a 300 Pen. The addition of polymer gives the binder true elastic recovery which results in increased resistance to compaction under traffic. It increases the binder's ability to retain aggregate and improves the binder's resistance to shrinkage cracking.

The combination of these improved characteristics provides a much tougher and more durable pavement with an increase in life expectancy of up to twice that of normal bitumen.

Due to the greatly increased ductility and the new property of elastic recovery, the rubberised SAM can be used over cracked sealcoats or cracked AC pavements with greatly reduced risk of these cracks reflecting through the new seal and the attendant problem of water penetrating to the sub-base.

When to Use a SAM

On structurally sound urban streets, trunk roads and rural highways which exhibit shrinkage or fatigue cracking problems. The use of a rubberised SAM permits resealing of pavements with deflections of 1.25mm or even greater.

On roads where aggressive climatic conditions are causing rapid ageing of normal bitumen binders with early loss of aggregate. Overseas experience has shown that seal life can be extended by up to 100% by the addition of the appropriate amounts of rubber under these conditions.

In hot plants for production of rubberised open graded mixes to give greater durability to these mixes.

What Does a SAM Cost

The additional cost for a 10mm rubberised seal can be as little as 6 cents per square metre where rubber is used to improve bitumen ductility, to 40 cents per square metre where a high percentage of rubber is used to treat a badly cracked pavement.

Stress Absorbing Membrane Interlayer (SAMI)

The application of a SAMI allows a pavement which has been overlaid to move differentially in relation to the new overlay i.e. movement of the original pavement is not transmitted to the 'new overlay' as would normally be the case with a conventionally overlaid pavement. Research by Monismith and Coetzee has shown that this reduces stresses created by cracks in the pavement being overlaid to 15% or less in the new overlay and prevents these cracks reflecting through the new overlay.

The membrane prevents surface water from entering the road sub-base and sub-grade and thus eliminates a major cause of pavement failure. As water is not able to enter the sub-base a more effective use can be made of 'Open Graded Friction Courses' for improved skid resistance and to prevent aquaplaning.

The research carried out by Monismith and Coetzee has shown the bond between pavement and overlay is many times greater with a rubberised SAMI than emulsion or bitumen tack coats. The risk of delamination, in particular with thin overlays, is virtually eliminated.

When to Use SAMI

A SAMI is used when overlaying structurally sound medium to heavy traffic density suburban and arterial roads and highways which exhibit stress or shrinkage cracking. Also when overlaying Portland cement concrete roads, overhead expressways and bridge decks. Here the membrane prevents the reflection of cracks or joints into the overlay, and also prevent penetration of water to the reinforcement.

Some road Authorities now consider it to be good engineering practice to include a membrane as a means of preventing future surface failure. One such example is the Arizona Highways Department. They include a rubber membrane in all overlays of 100mm or less.

What Does a SAMI Cost

Monismith and Coetzee have shown that a 50mm overlay with a 2.5mm thick rubberised membrane is equal to an overlay of 190mm without a SAMI in its ability to prevent reflective cracking. At current Australian costs this represents a nett saving of \$15 per square metre.

It is conceded that we would seldom consider overlays of 190mm. Nevertheless, in light of the evidence from the recent research work of Coetzee and Monismith on rubber membranes to overlay a cracked pavement without the inclusion of a SAMI, must now be considered unsound engineering practice.

It is well established that a new overlay over a cracked pavement will reflect the cracks through a 50mm layer without SAMI in 2 years or less, whereas with the inclusion of a SAMI the life expectancy will be 10 years or more. With the cost of a SAMI at approximately the cost of 25mm of B.C. the cost effectiveness is therefore a 50% cost increase for a 400% increase in anticipated life.

In a high percentage of urban streets, though they are structurally serviceable, the only real alternative to the use of a SAM or SAMI is partial or total reconstruction to remove the cracked pavement and the underlying cause. Under the circumstances the typical cost of SAMI and 25mm overlay is \$6 to \$7/m² as opposed to reconstruction at \$15 to \$20/m².

SAM 'C' Concentrate

The value of combining rubber with bitumen has been recognised since its first recorded use in Europe in the 1930's. The difficulty has always been to conveniently combine the two materials in a controlled manner under "field practice". The research personnel of our manufacturing company overcame this problem in 1979 with the development of SAM 'C'.

SAM 'C' is a predigested blend of synthetic rubber and bitumen in a concentrated form which is manufactured under closely controlled plant conditions to provide uniformity of specification. Because SAM 'C' is predigested in the plant, it readily combines with bitumen to permanently modify and give predetermined properties including elastic recovery to the rubberised bitumen.

Use of SAM 'C'

By combining SAM 'C' with Class 170 Bitumen (nominally 80-100 Pen grade) in various ratios from 1:1 through to 20:1, a rubberised bitumen of the required properties can be readily produced in "the field" to meet virtually all road requirements.

The rubberised bitumen will be used either as a S.A.M. (Stress Absorbing Membrane) that is, a single or double coat seal with elastic recovery.

Alternatively, it can be used as a S.A.M.I. (Stress Absorbing Membrane Interlayer). Here the highly rubberised bitumen, normally 2:1 concentration or greater, is sprayed over a cracked bituminous or Portland cement concrete pavement, then overlaid with bituminous or asphaltic concrete. The membrane thus becomes an "interlayer".

What Does a SAMI Cost

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Quanto costa SAMI

Monismith e Coetzee hanno dimostrato che una copertura di 50 mm con membrana gommata di spessore 2,5 mm equivale a una copertura di 190 mm senza SAMI con la sua capacità di prevenire la fessurazione di riflessione. Ai costi correnti australiani ciò rappresenta un risparmio netto di 15 \$ per metro quadro.

Application and Blending of SAM 'C'

A conventional bitumen sprayer using standard jets and with no modification is all that is necessary to apply even the maximum concentration of SAM 'C' and bitumen. Hot bitumen is added to the SAM 'C' blocks in the sprayer or a blending tank which has circulation. Blending of the concentrate is best done the day before use. If necessary the blocks can be cut into smaller sizes using a spade heated with a gas flame to speed up the melting process (the plastic outer layer melts with the block). Once the blocks have completely melted in the bitumen the binder is circulated to ensure a thorough blend and heated to 190°C. Spraying temperature is 175 to 190°C. On completion of spraying, bars are cleaned using the same procedure as with bitumen.

Packaging

SAM 'C' is available as Hot Bulk liquid from our manufacturing plant or packaged in 20kg block in soluble plastic packed in cartons.

Blends of SAM 'C'

Page 5 of this bulletin sets out typical specifications to SAM 'C' blended at ratios of 1:1 through to 20:1 with "Reference" bitumen of Class 170 specification.

There are three completely separate categories for the use of SAM 'C' and each requires a different set of blend ratios. The categories are:

- 1 S.A.M. Stress Absorbing Membrane used for Spray Seals
- 2 S.A.M.I. Membrane Interlayers
- 3 Single Coat S.A.M.'s

You will see at the right hand side of the specification the ratios for this application are 1:1, 1.5:1 and 2:1. Typically 1:1 is used on areas where there is heavy traffic and/or higher deflections and 2:1 is used in light traffic lower deflection areas. In the most severe applications such as the overlaying of concrete roads or very high deflection areas a plant blended rubber SAMISEAL R.C. is used. Depending on the severity of the application the membrane is overlaid with either a dense graded A.C. or an open graded friction course.

Stress Absorbing Membrane (SAM) used for Spray Seals

These are 2 coat surface membranes incorporating different sizes of aggregate and different ratios of SAM 'C' for each coat. You will see from the specification sheet that in the bottom coat a higher ratio of rubber is used, that is, 2:1, 3:1 and 4:1. This is to provide a resilient connection to the existing aged or cracked pavement. The top coat employs a small amount of rubber, 10:1 or 20:1. This provides a stiffer bond between the two coats and resists 'traffic scrub' on the running surface.

With the bottom coat the higher ratios of SAM 'C' are used on the most severe application. With the top coat however, the reverse applies and lower ratios of rubber are used on the heaviest traffic applications as this provides a stiffer surface to resist traffic scrub.

S.A.M. Surface Membranes are used on badly cracked A.C. or sealcoat pavements with high deflections as a much higher ratio of rubber can be used on the bottom coat that would be possible with a single seal.

Stess Absorbing Membrane Interlayer (SAMI)

The membrane interlayer acts as a water barrier and crack retardant between the existing surface and the new asphalt surface. Once the binder is sprayed an application of aggregate is applied. This aggregate layer is to allow paver laying equipment to operate on the membrane without "pick-up" occurring. The amount of "pick-up" is also dependent on both aggregate size and application rate.

Single Coat SAM's

As you increase the ratio of SAM 'C' rubber to bitumen the cohesive strength of the blend is increased and ability to hold aggregate its adhesive strength is decreased. For this reason the maximum ration of SAM 'C' rubber which should be used in a single coat rubberised seal is 4:1. You will see from the specification sheet that the recommended ratios are from 4:1 down to 20:1, the higher rubber ratio being used on the more severely cracked pavements. A ratio of 20:1 SAM 'C' when sprayed without cutter or flux will give immediate adhesion and prevent early wheelpath stripping on highways and other heavily trafficked roads.

Do Not:-

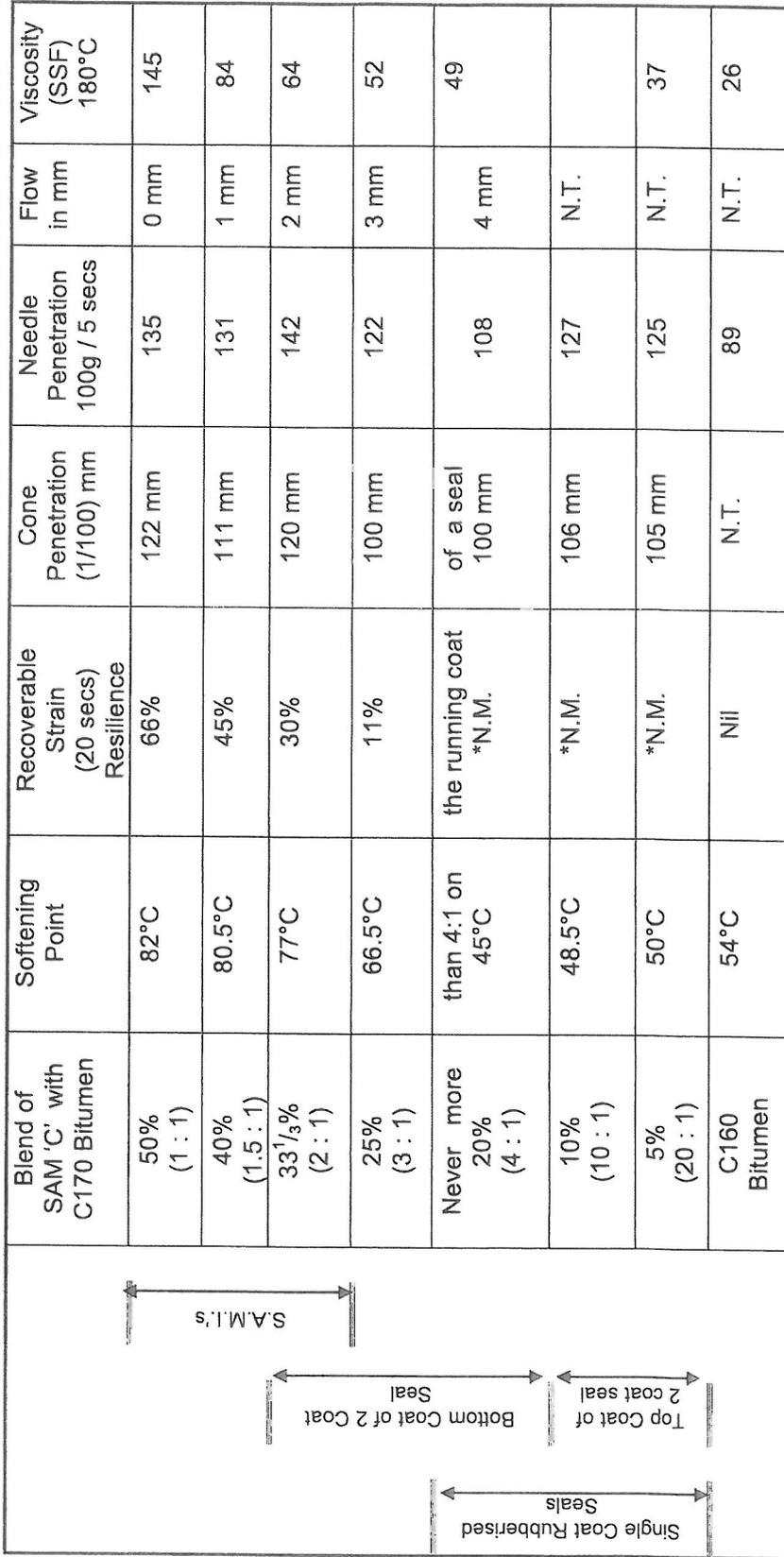
Spray on a wet/damp pavement or when rain is pending
Spray when the pavement temperature is less than 15°C
Spray on an un-primed or dusty surface
Heat the binder above 195°C
Spray below 180°C (spray temperature to be 185°C – 195°C)
Spray without 1% adhesion agent
Spray with more than 5% cutter (and preferably none at all)
Use wet aggregate (damp is normally OK)
Over precoat aggregates - only sufficient to kill the dust (preferably without distillate)
Be slow in applying the aggregate on the newly sprayed surface

Wherever possible give at least one pass with a steel roller on each coat (provided the aggregate will stand it) and a further five passes with a rubber tyred roller.

NOTE: Because a polymer modified binder is flexible, the aggregate continues to move against adjoining stone. It is therefore necessary to choose the strongest possible aggregate.

NOTE: Whilst every care is taken in the preparation of this bulletin, no responsibility is accepted for the interpretation of the information contained herein, nor is any warranty expressed or implied for the suitability of the material for a particular purpose.

TYPICAL SPECIFICATION WHEN SAM 'C' RUBBER CONCENTRATE IS BLENDED WITH C170 "REFERENCE" BITUMEN



Blend of SAM 'C' with C170 Bitumen	Softening Point	Recoverable Strain (20 secs) Resilience	Cone Penetration (1/100) mm	Needle Penetration 100g / 5 secs	Flow in mm	Viscosity (SSF) 180°C
50% (1 : 1)	82°C	66%	122 mm	135	0 mm	145
40% (1.5 : 1)	80.5°C	45%	111 mm	131	1 mm	84
33 ¹ / ₃ % (2 : 1)	77°C	30%	120 mm	142	2 mm	64
25% (3 : 1)	66.5°C	11%	100 mm	122	3 mm	52
Never more than 4:1 on 20% (4 : 1)	than 4:1 on 45°C	the running coat *N.M.	of a seal 100 mm	108	4 mm	49
10% (10 : 1)	48.5°C	*N.M.	106 mm	127	N.T.	
5% (20 : 1)	50°C	*N.M.	105 mm	125	N.T.	37
C160 Bitumen	54°C	Nil	N.T.	89	N.T.	26

*Low orders of resilience are "not measureable" under Colorado test procedures due to the nature of the test procedure.