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## TECHNICAL BULLETIN #18

## SAMI Bitumen Technologies

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

### Description

The value of combining synthetic rubber (polymers) 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 at SAMI Bitumen Technologies overcame this problem with the development of SAM 'C'.

SAM 'C' is a pre-digested blend of synthetic rubber and bitumen in a concentrated form to provide uniformity of specification. Because SAM 'C' is pre-digested in the plant, it readily combines with bitumen to permanently modify and give predetermined properties including elastic recovery to the modified 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 polymer modified bitumen with the required properties can be readily produced in "the field" to meet virtually all road requirements.

The polymer modified bitumen can be used either as a SAM (Stress Absorbing Membrane) or as a SAMI (Stress Absorbing Membrane Interlayer). As a SAMI 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".

### 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, arterial roads and 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. Experience has shown that seal life can be extended by 80- 100% by use of a polymer modified binder under these conditions.

### What Does a SAM Cost

The additional cost for a 10mm rubberised seal can be as little as 8 cents per square metre where polymer is used to improve bitumen ductility and up to 50 cents per square metre where a high percentage of polymer 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.

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The SAMI 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' mixes 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 and include a SAMI 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. It is conceded that we would seldom consider overlays of 190mm, nevertheless, in light of the evidence from the research work of Coetzee and Monismith on polymer modified membranes, to overlay a cracked pavement without the inclusion of a SAMI, must 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 membrane within 2 years, 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 same cost of 25mm of AC, 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 by far outweighs the cost of reconstruction.

### 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 typically 185 - 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 or packaged in 20kg block in soluble plastic packed in cartons.

### Blends of SAM 'C'

Page 4 of this bulletin sets out typical properties of Class 170 reference bitumen when blended with SAM 'C' at various ratios from 1:1 through to 20:1.

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

- 1 Single coat S.A.M seal
- 2 Two coat S.A.M seal
- 3 S.A.M.I Membrane Interlayers

### Single Coat SAM Seal

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.

### Two Coat SAM Seal

These are 2 coat surface membranes incorporating different sizes of aggregate and different ratios of SAM 'C' for each coat. You will see from page 4 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.

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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.

SAM 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.

### **Stress Absorbing Membrane Interlayer (SAMI)**

For a SAMI blend, ratios of 1:1 are typically used on areas where there is heavy traffic and/or higher deflections, and 2:1 is used in light traffic lower deflection areas. The SAMI is then covered with aggregate before being overlaid asphalt.

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.

### **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
- 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

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.

Page 4 of this technical bulletin shows the typical properties of various blends.

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Typical Binder Properties when SAM 'C' 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 <sup>1</sup> / <sub>3</sub> % (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 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
	C170 Bitumen	54°C	Nil	N.T.	89	N.T.	26

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

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