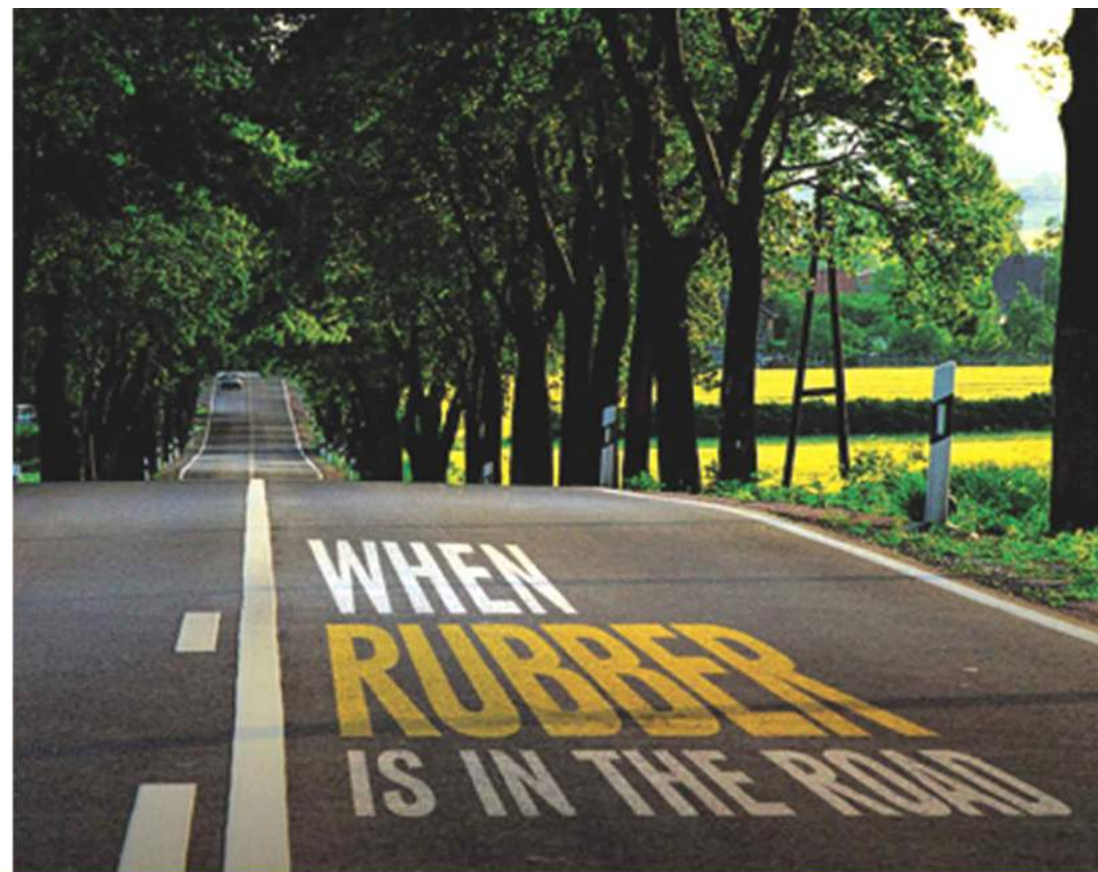




**ELASTOMERS & TIRE
INDUSTRIAL SOLUTIONS**



**RUBBERIZED ASPHALT MODIFIER
GREEN PAVEMENT SOLUTION**

ACTEN



info@actengroup.com.my

www.actengroup.com.my

Green Pavement : An Introduction

Global infrastructure network is developing at a lightning speed, with billion miles of road crisscross the world. Wide freeways cut through huge cities, streets wind through residential and agricultural areas. When a road develops potholes, cracks, or other problems that require construction, the resulting detours and delays, or worst, accidents. Conventional pavements are made of either asphalt or concrete, these materials require major maintenance every 10 to 20 years. The high maintenance cost has called for a better, modified materials in replacement or to refine regular asphalt.

*" New Roads made with
rubberized asphalt modifier
will last longer. "*

FLEXIBLE. RESILIENT. ECO-FRIENDLY

As a by-product of an industry that exists all over the world, the used tyres that remain after their life on vehicles has ended. Ground tyre rubber also helpfully has resilient properties that can be used to enhance the performance of construction products.

For the asphalt industry, which currently depends on materials with very high embedded energy costs - polymer-modified bitumen is expensive in carbon terms both to make and to transport and store - asphalt modifier with rubber concentrate from ground recycles tyres could therefore offer a welcome solution to greenhouse gas emissions associated with traditional asphalt manufacturing.

And because new roads made with asphalt modifier with rubber will last longer, relatively lower material cost, both government and industry could save millions of dollars as well as thousands of tons of CO2.

After a rather slow rate of adoption among municipal and governments, new technology combined with an increased focus on environment and a greater understanding of product are making rubberized asphalt the preferred paving product for the nation roadways and interstates.



Maintenance and rehabilitation, which calls for more customised treatment technology and materials will become the key drive of the pavement construction. Traditionally, the asphalt used has only standard asphalt or SBS modified asphalt as material options. It is far insufficient to meet different requirements, taking in accounts for various factors such as weather, traffic, load, soil conditions. Lacking of new, better and diversified materials will continue to cause the hazards on the road.

Rubberized asphalt pocesses attributes including reduced maintenance requirements, greater skid resistance, lower noise generation and improves performance. The new stabilized polymer composite modifiers , based on recycle tire crumbs is a revolutionary developments for paving construction, with a clear leverage over SBS modified asphalt.



Polymer Composite Modifier Asphalt

Surface Layer (wearing course)

PCMA comes with carbon black and anti-aging activators. It will relatively increase the shelf-life & color of the surface layer. Besides, the advantage of the rubber in crack-resistance will be reinforced, the odds of non-structural cracks will be reduced significantly. Fiber is not added in the PCMA, hence the manufacturing cost is lower than SBS modified with fiber construction.

Middle Layer (rut-resistance)

PCMA has better performance in rut-resistance, due to the characteristic of rubber components. The normal rut-resistance agent used in SBS modifier will face the cracking problems and performance degradation during lower temperature. However, these disadvantages are eliminated in the application of PCMA.

Base Layer (crack-resistance)

Crack resistance is the absolute advantage of PCMA in comparison with other SBS modified asphalt, especially at the base layer, where heat is not the main factor here. The fatigue resistance of PCMA is doubled up compare to SBS, and 10 times or more better than normal asphalt.

Waterproof bond stress absorbing intermediate layer

The viscosity of PCMA in high temperature is few times greater than SBS modified asphalt, and its crack-resistance performance in low temperature is better than SBS too. This bonding layer will become a key factor in providing a pavement with longer shelf-life.

Polymer Composite Modifier Asphalt (PCMA)

V.S

SBS Modified Asphalt

Cost Comparison between Common model and PCMA heavy functional highway pavement

Layer	PCMA model	Cost /m2 (USD)	Common model	Cost /m2 (USD)
Surface Layer	4 cm PCMA-G non fiber	10.90	4 cm SBS modified asphalt mix	11.50
Bonding Oil	SBS modified asphalt	0.38	SBS modified asphalt	0.38
Middle Layer	6 cm PCMA -M	9.87	6 cm SBS modified asphalt AC-20C	9.87
Bonding Layer	Modified Asphalt Emulsion	0.28	Modified Asphalt Emulsion	0.28
Base Layer	8 cm PCMA-G mixture	14.00	8cm 70# Asphalt AC-25C	10.60
Bonding Oil	-		Modified Asphalt Emulsion	0.28
Soft base	-		10cm 70# Asphalt ATB-30	10.50
Waterproof SAMI	PCMA SAMI gravel mixture	4.08	SBS modified asphalt gravel mixture	2.50
Prime Coat	-		PC-2 Asphalt Emulsion	1.00
Total		39.51		46.91

- Surface layer is the wearing coarse, main features emphasize on comfort, weatherability and anti-aging. PCMA-G has better performances in compare to SBS modified asphalt SMA , with equal oil consumption, but lower manufacturing cost as fiber is not needed here.

- The middle layer has the highest rutting occurrence, with the application of PCMA-G, the rut-resistance had been increase by 100%, without affecting low temperature performance.

- The soft base is not required at the base layer, the waterproof PCMA SAMI has the same crack-resistance effect of 3cm asphalt mixture. It eliminates the hidden danger of having spaces between layers and the water impact on the prime coat.

New Paving Model Material Consumption Reference Table

Highway Lane	4	6	8
Road Width (m)	22.5	30	37.5
Area per km (m2)	22500	30000	37500
Modified Asphalt (t /km)	584.3	779.1	973.9
Polymer Modifier Agent (t / km)	105.5	140.7	175.9

Stabilized Polymer Composite Modifiers (PCMA)

Technical Aspect

Polymer Composite Modifier Asphalt (PCMA series), based on classified recycled polymers (waste tire crumbs), produced by self-developed molecular weight control and stabilized polymer composite process, could present characteristics and advantages in asphalt modification and applications. The end products is stabilized, eliminating the occurrence of modifier segregation or decay of physical properties.

PCMA-C Lower Viscosity at high temperature, suitable for continuous dense distribution, great overall performance

PCMA-G Higher Viscosity at high temperature, high anti-leakage ability, open-graded & SAMI

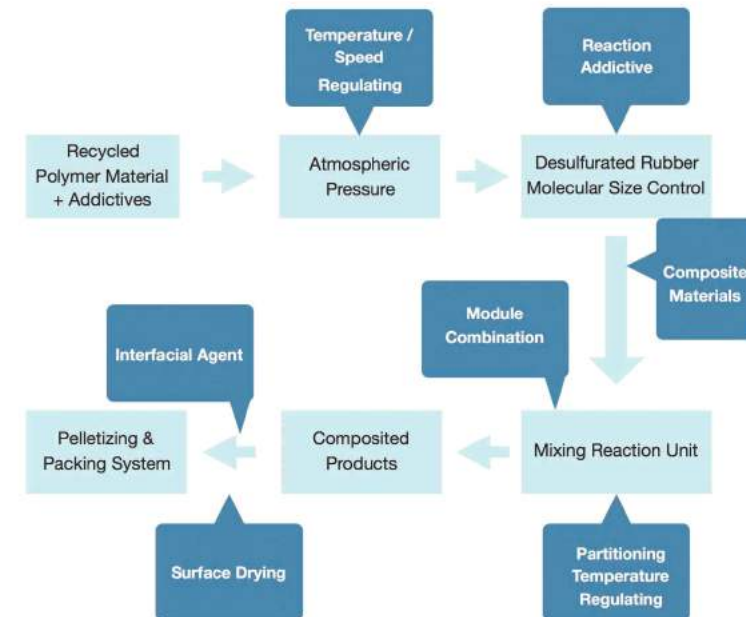
PCMA-M For High modulus asphalt mixture, high anti-rutting ability, effectively balance low temperature performance

PCMA-V For High Viscosity, suitable for heavy loading traffic, open-graded surface level, SAMI, steel deck pavement



Technical Index	Unit	PCMA-C	PCMA-M	PCMA-G	PCMA-V	Experiment Method
Penetration (25°C, 5s, 100g)	0.1 mm	40 ~ 60	30 ~ 60	30 ~ 60	40 ~ 60	JTG E20 T0604
Softening Point R&B	°C	55	60	55	85	JTG E20 T0606
180°C Kinematic Viscosity	Pa. s	-	-	1 ~ 4	-	JTG E20 T0625
135°C Kinematic Viscosity	Pa. s	3.0	4.0	-	-	JTG E20 T0625
60°C Dynamic Viscosity	Pa. s	-	2000	-	100000	JTG E20 T0620
Flash Point	°C	230	230	230	260	JTG E20 T0611
Resilient 25°C	%	50	-	55	60	JTG E20 T0662
Storage stability segregation, 48h softening point difference	°C	2.5	2.5	2.5	2.5	JTG E20 T0661
Post TFOT Residue						
Quality changes	%	+/- 1.0	+/- 1.0	+/- 0.8	+/- 0.8	JTG E20 T0610
Penetration ratio 25°C	%	60	60	60	70	JTG E20 T0604

Productss Customization Process



Material Variables :

- Rubber
- Elastomers, resin, TPE, PE wax, asphalt
- Surfactant, plasticising additives etc

Process Variables :

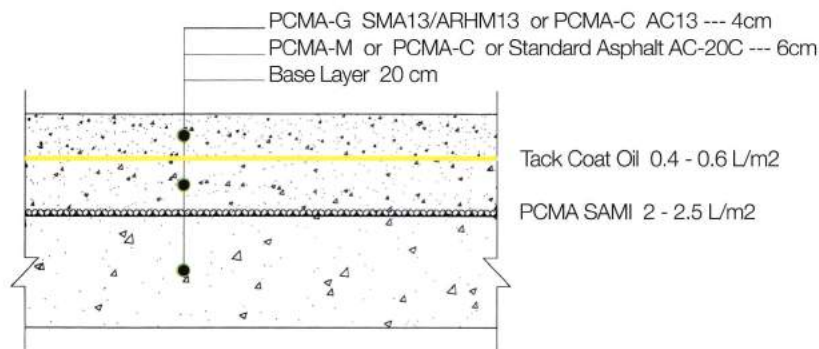
- Speed and temperature of plastication, blending reaction module combination, module partition temperature control, advancing speed of material



New General & Urban Road Solution

Structure Info & Description :

Surface Layer : Considering improvement on driving and safety performance, durability & appearance
 Middle Layer : Increase the performance stability in high temperature without compromising anti-rutting ability
 Waterproof and anti-crack reinforcement at the bonding interface between semi-rigid base layer & asphalt layer



Structure Info & Description :

Surface Layer : Adopt PCMA-G SMA or ARHM, reinforce anti-crack ability, improve driving comfort and safety
 Middle Layer : Adopt PCMA-M or PCMA-C mixture, increase stability and balances anti-rutting ability
 Adopt PCMA SAMI for the interface layer between base layer and middle layer

Cost Analysis & Comparison :

Adopting PCMA-G SMA/ARHM, the usage of asphalt is the same as SBS modified asphalt, (PCMA-G market price is no higher than SBS modified asphalt), but no additional fiber to be added, hence the final mixture will save USD 5.50 per ton

PCMA SAMI adopt gravel sealing method, asphalt usage is 2 - 2.5 kg/m², gravel usage is 15 - 25 kg/m², the construction using intelligent asphalt distributor and gravel sprinkler. PCMA SAMI costing around USD 4 ~ 4.25 /m²

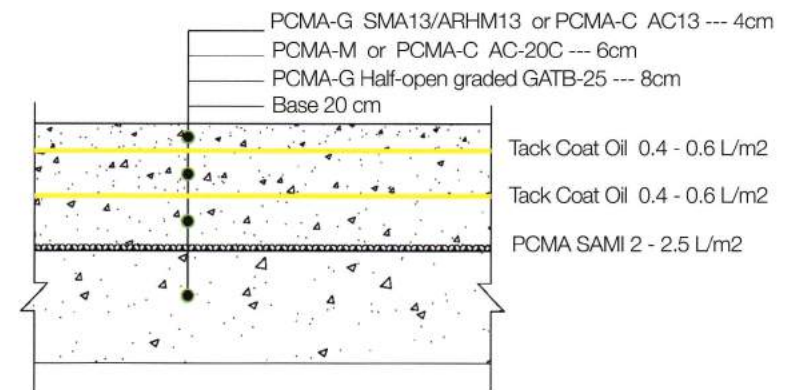
Adopting PCMA-M AC20, asphalt price and oil usage is almost equal to SBS modified asphalt, but anti-rut ability is increased, it is compatible with high quality anti-rut agent and cheaper by USD 5.30 / ton

New Highway & City Expressway Solution



Structure Info & Description :

Surface Layer : Considering improvement on driving and safety performance, durability & appearance
 Middle Layer : Increase the performance stability in high temperature without compromising anti-rutting ability
 Base Layer : Increase anti-rut performance



Structure Info & Description :

Surface Layer : Adopt PCMA-G SMA or ARHM, reinforce anti-crack ability, improve driving comfort and safety
 Middle Layer : Adopt PCMA-M or PCMA-C mixture, increase stability and balances anti-rutting ability
 Heavy Load bottom layer adopt PCMA-G half open-graded GATB-25
 Adopt PCMA SAMI for the interface layer between base layer and middle layer

Cost Analysis & Comparison :

Adopting PCMA-G SMA/ARHM, the usage of asphalt is the same as SBS modified asphalt, (PCMA-G market price is no higher than SBS modified asphalt), but no additional fiber to be added, hence the final mixture will save USD 5.50 per ton

PCMA SAMI adopt gravel sealing method, asphalt usage is 2 - 2.5 kg/m², gravel usage is 15 - 25 kg/m², the construction using intelligent asphalt distributor and gravel sprinkler. PCMA SAMI costing around USD 4 ~ 4.25 /m²

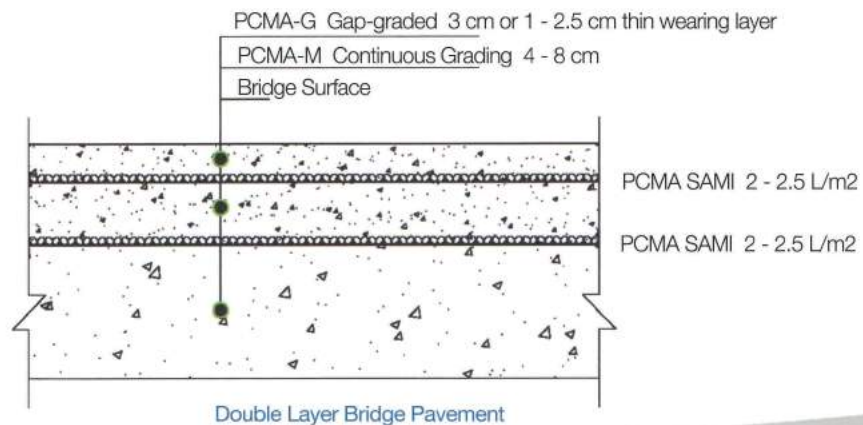
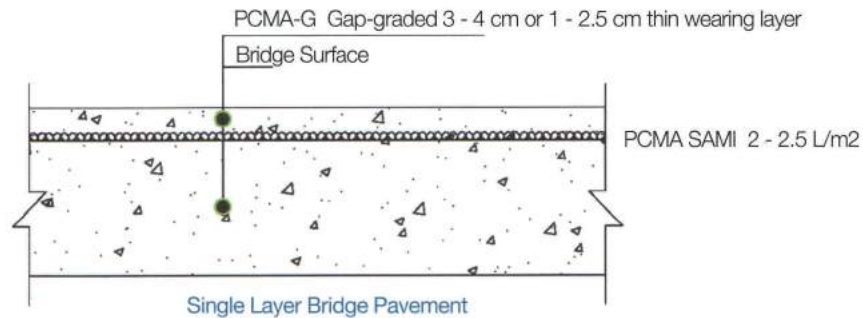
Adopting PCMA-M AC20, asphalt price and oil usage is almost equal to SBS modified asphalt, but anti-rut ability is increased, it is compatible with high quality anti-rut agent and cheaper by USD 5.30 / ton

PCMA-G half open graded GATB-25. doubling the anti-rut ability, able to bond with SAMI, and eliminate flexible base.

Cement Bridge Pavement

Solution Info & Description :

The pavement for cement bridge, do not have issue with deep in or fatigue, but the drainage and temperature conditions are worse than standard pavement. The bonding between layers are essential, the layer between bridge surface and asphalt layer must reinforce bonding and water-proof ability.



Structure Info & Description :

Wear Layer : Adopt PCMA-G SMA/ARHM, reinforce anti-cracking ability, reduce the segregation at the thickness direction, increase the driving comfort and safety

Leveling Layer & Base Layer use PCMA-M mixture, increase anti-cracking ability and dynamic stability

Adopt PCMA SAMI for the bonding between leveling layer and bridge surface.



Cost Analysis & Comparison :

Adopting PCMA-G SMA/ARHM, the usage of asphalt is the same as SBS modified asphalt, (PCMA-G market price is no higher than SBS modified asphalt), but no additional fiber to be added, hence the final mixture will save USD 5.50 per ton

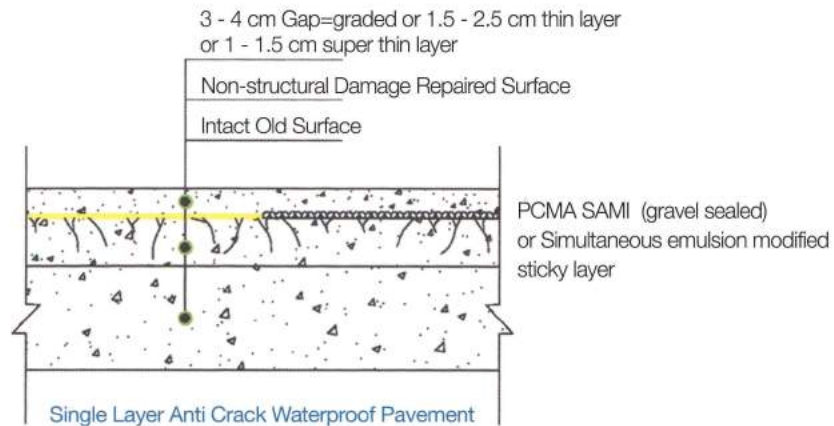
PCMA SAMI adopt gravel sealing method, asphalt usage is 2 - 2.5 kg/m², gravel usage is 15 - 25 kg/m², the construction using intelligent asphalt distributor and gravel sprinkler. PCMA SAMI costing around USD 4 ~ 4.25 /m²

Adopting PCMA-M AC20, asphalt price and oil usage is almost equal to SBS modified asphalt, but anti-rut ability is increased, it is compatible with high quality anti-rut agent and cheaper by USD 5.30 / ton

Single Layer Anti-Crack Water-proof Pavement

Solution Info & Description :

According to the non-structural damage from the pavement surface, in deciding the pavement thickness or material choice, replace or substitute the unstable part, reduce abrasion of the original pavement structure, reinforce the bonding between new and old pavement, adopt thinner pavement if possible, the new wearing layer must have significant improvement in the anti-crack ability and driving performance (anti-slip, noise reduction)



Partial repair and leveling. Avoid excavating and disturbing old pavement. Only repair and excavate unstable parts or holes, ignoring the non-structua defects. Maintain the dryness and cleanliness of the old pavement surface.

Bonding layer is very important for the single layer pavement below 4cm, for pavement above 2.5 cm, should first consider PCMA SAMI gravel sealing. For pavement below 2.0 cm, adopt asphalt modified gravel sealing or use simultaneous emulsion modified bonding oil as bonding layer.

Considering anti-slip, noise reduction and anti-cracking ability, for 2.5 - 4cm pavement should use PCMA gap-graded. For pavement below 2.5 cm, use different grades of high viscosity modified asphalt open graded or semi open graded mixtures, thinner the layer, higher the viscosity.

Applicable Cases :

This solution is suitable for non-structural problems such as the peeling of the surface layer, water damage, crackle, that result from aging and temperature fatigueness.

During the application of asphalt pavement, if it is not structural damage, the most common way is to excavate and adding new coating.



Highway 2.5cm gap-graded wearing layer pavement



City road 1cm thin wearing layer

Cost Analysis & Comparison :

Base on asphalt price @ USD 375/tons

Pavement Type	Cost (USD /m2)
4 cm Gap Graded + SAMI gravel	11.95
3 cm Gap Graded + SAMI gravel	9.90
2.5 cm semi Open Graded + SAMI gravel	8.40
2.5 cm Semi Open Graded + Simul Emulsion Modified	8.57
1 cm Super Thin + Simul-Emulsion Modified	8.10