AAPA's 14th International Flexible Pavements Conference

Sydney
25–28 September 2011

Pavement Sustainability and Bituminous Emulsions

John Lysenko
Technical Development Manager, Binders
Fulton Hogan Industries, Australia

Sustainability

- Sustainable development principles and practice
- More sustainable approach to road construction and maintenance
- Bitumen emulsions have a role in the conservation of non-renewable resources and reduction of environmental impact of the pavement maintenance process

Sustainability definition

- "Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs"(1)
- A pavement that "minimises environmental impacts through the reduction of energy consumption, natural resources and associated emissions while meeting all performance conditions and standards"(2)

(1) Brundtland Report (1987)
(2) Miller T, & Bahia H

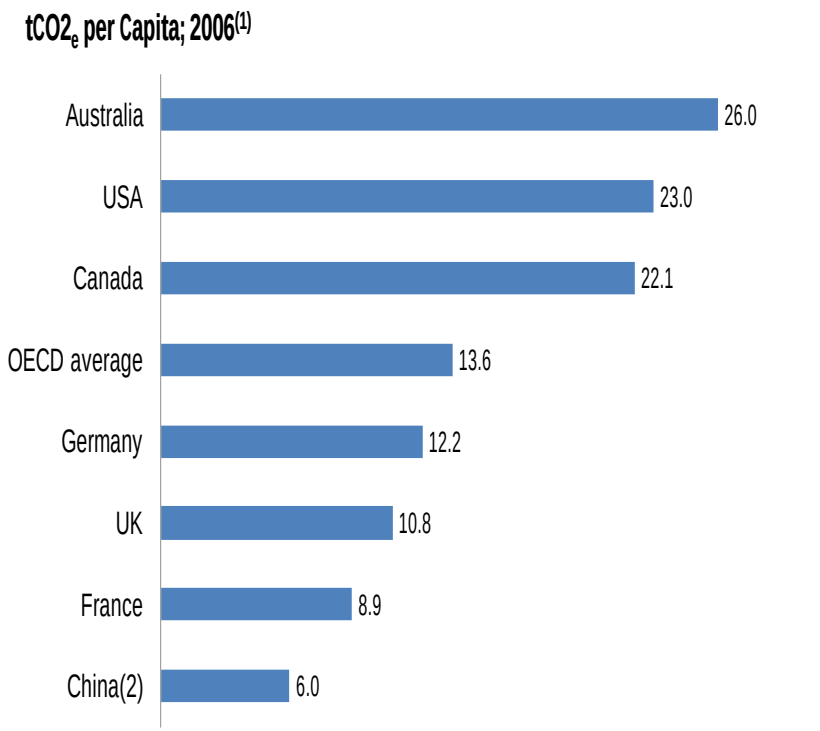
Sustainability factors

- Conservation of pavement materials
  - Recycling reduces raw material consumption and cold in situ recycling (CIR) has potential to conserve both materials and energy
- Reduced energy consumption
  - Low temperature applications such as warm mixes and emulsion based surfacings e.g. Microsurfacing, cold mixes, chip seals
  - CIR offers potential energy savings of up to 35% on overlays and 70% over reconstruction using foamed and emulsion technologies
  - Chip seals applied with emulsions reduce storage and application temperatures

Sustainability factors (cont.)

- Emissions to the environment
  - Sources;
    - Heating to process, store and apply materials
    - Use of volatile hydrocarbons in binders
    - transportation of raw materials and products
  - Impacts on;
    - Air quality
    - Green house gases
    - Ozone depletion

Greenhouse gases (CO_{2e} emissions)



(1) Includes all localemissions , regardless of where locally manufactured or created goods (e.g. cattle or aluminium) are consumed
(2) Cina data is 2005
Source: UN statistics Division (2009), US Congressional Research Service (2008)

Despite ongoing debate about climate change, there is widespread and growing commitment towards a transition to a low carbon economy

Role of emulsions in ‘green’ roads

Examples of emulsion uses in sustainable roads

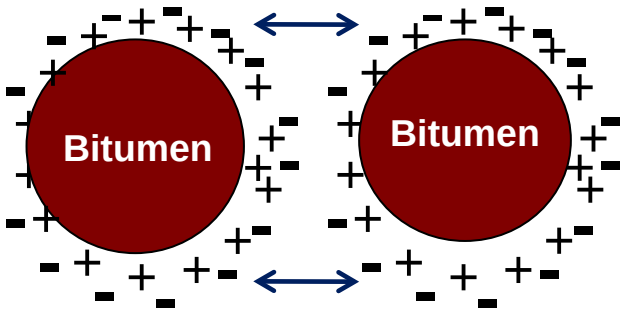
- Cold mixes
- Cold in situ recycling
- Microsurfacing
- Chip seals
- Enrichment
- Rejuvenation

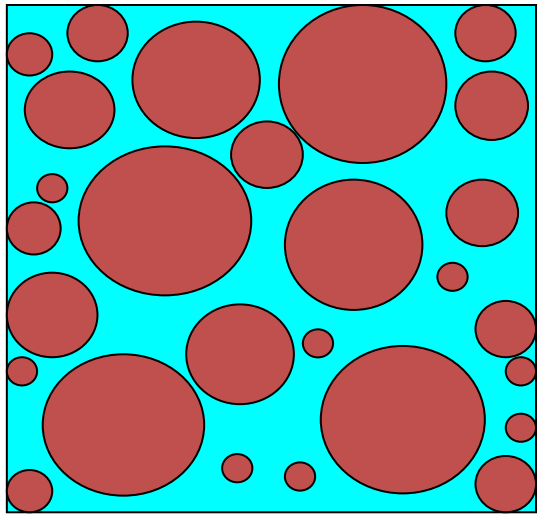
Emulsion enrichment and rejuvenation

- Sprayed enrichment surface treatments (SEST) have been available in Australia for many years
- Both emulsion and cutback bitumens have been used
- Some concerns;
  - Slow curing
  - Reduced skid resistance

Bitumen emulsions

Bituminous emulsions as used in road construction and maintenance are predominantly dispersions of bituminous material in water





Combined enrichment and rejuvenation

Cost effective where;

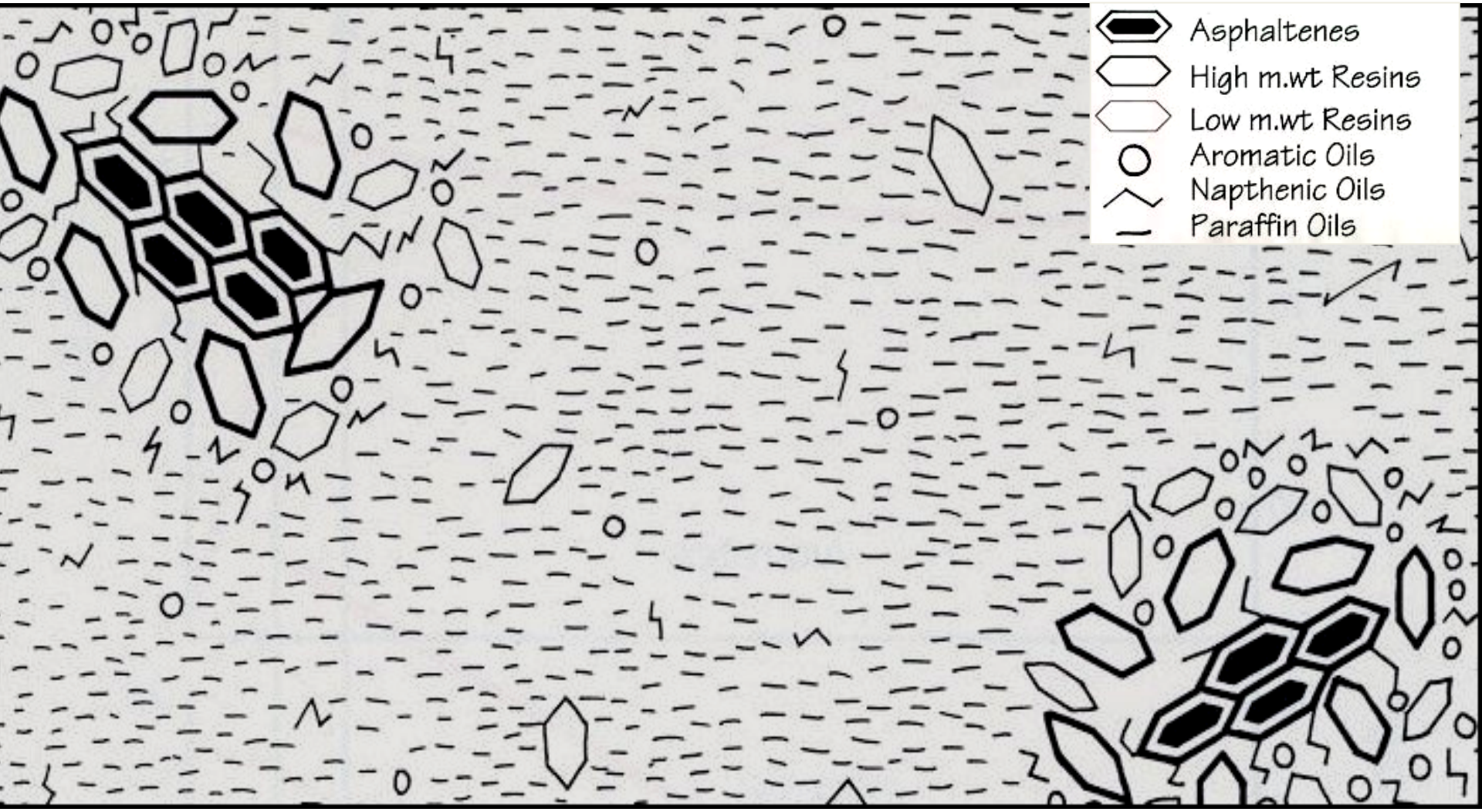
- Underlying pavement is sound
- Aggregate cover is substantially intact
- Surface aggregates are in good condition
- Pavement binder is depleted/embrittled

Typical applications include airport runways and shoulders and rural highways

Sprayed Enrichment Rejuvenation Treatment

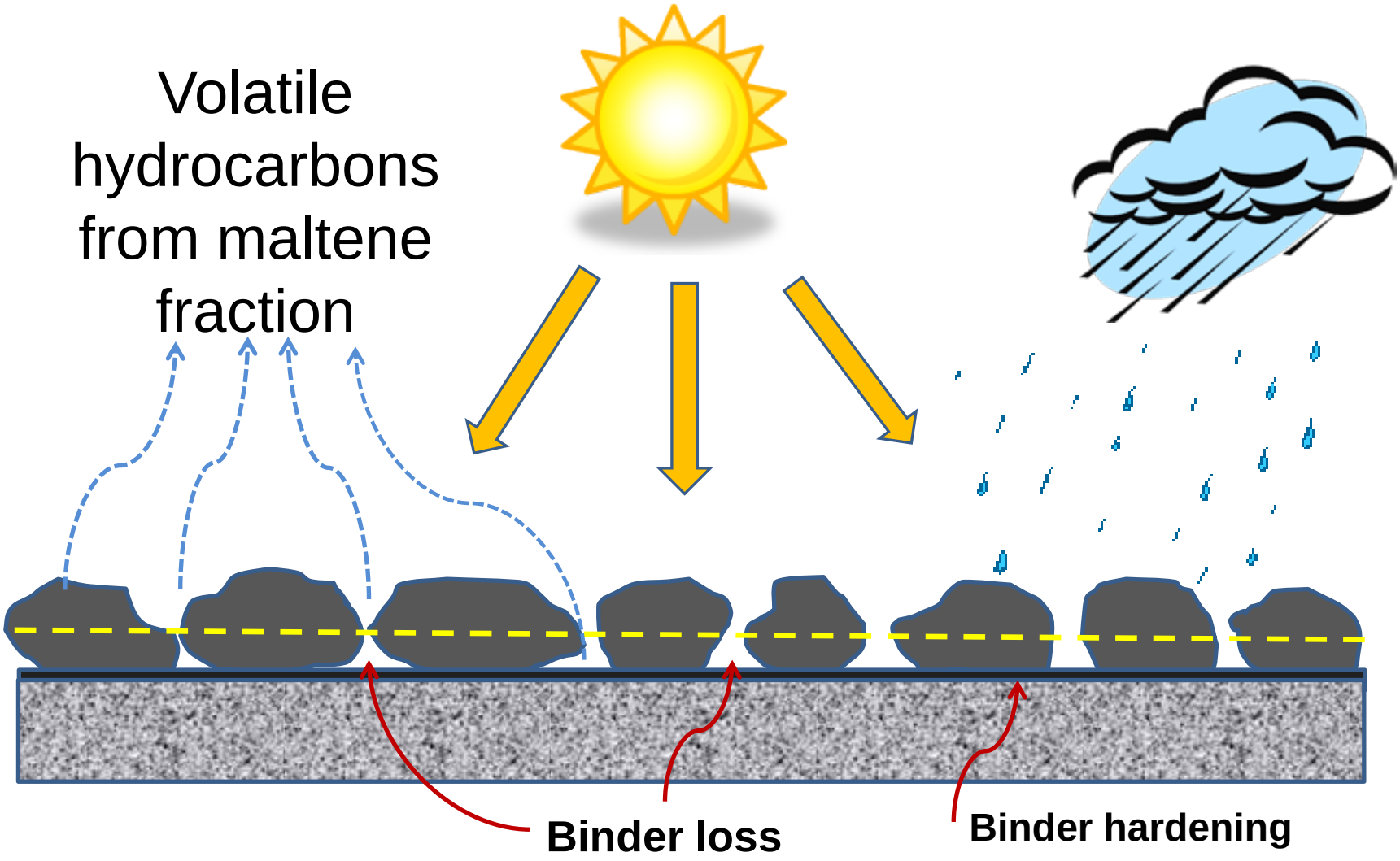
- SERT comprises a water based emulsion containing;
  - Ø bitumen
  - Ø rejuvenating oil and
  - Ø elastomeric polymer
- designed to extend pavement life by rejuvenating the aged residual bitumen and replacing bitumen lost through weathering with a premium binder

Schematic Representation of Bitumen
(Sol Type)



Shell Bitumen Industrial Handbook, 1995

Bitumen ageing



Pavements suitable for SERT

Patch Testing Mackay Airport

Patch testing on runway surface to establish the optimum application rate

SERT Trials Mackay Airport 2006

Sampling pavement before treatment

Original surface

Dry coring

Mackay airport runway core analysis

- A rejuvenation/ enrichment trial was carried out on a section of Mackay Airport runway to determine the optimum application rate and assess the cure time for the SERT product.
- Cores were taken from both treated and untreated sections to assess the effect of the treatment on the upper asphalt layer.
- The top 7mm of the cores was trimmed and used in the analysis.
- Binder was extracted from the trimmed layer using a method based on VicRoads Test Method 212.01 (1996). Micro-viscosity measurements were made by Shell Sliding Plate viscometer at 45^0C.

Moranbah airport

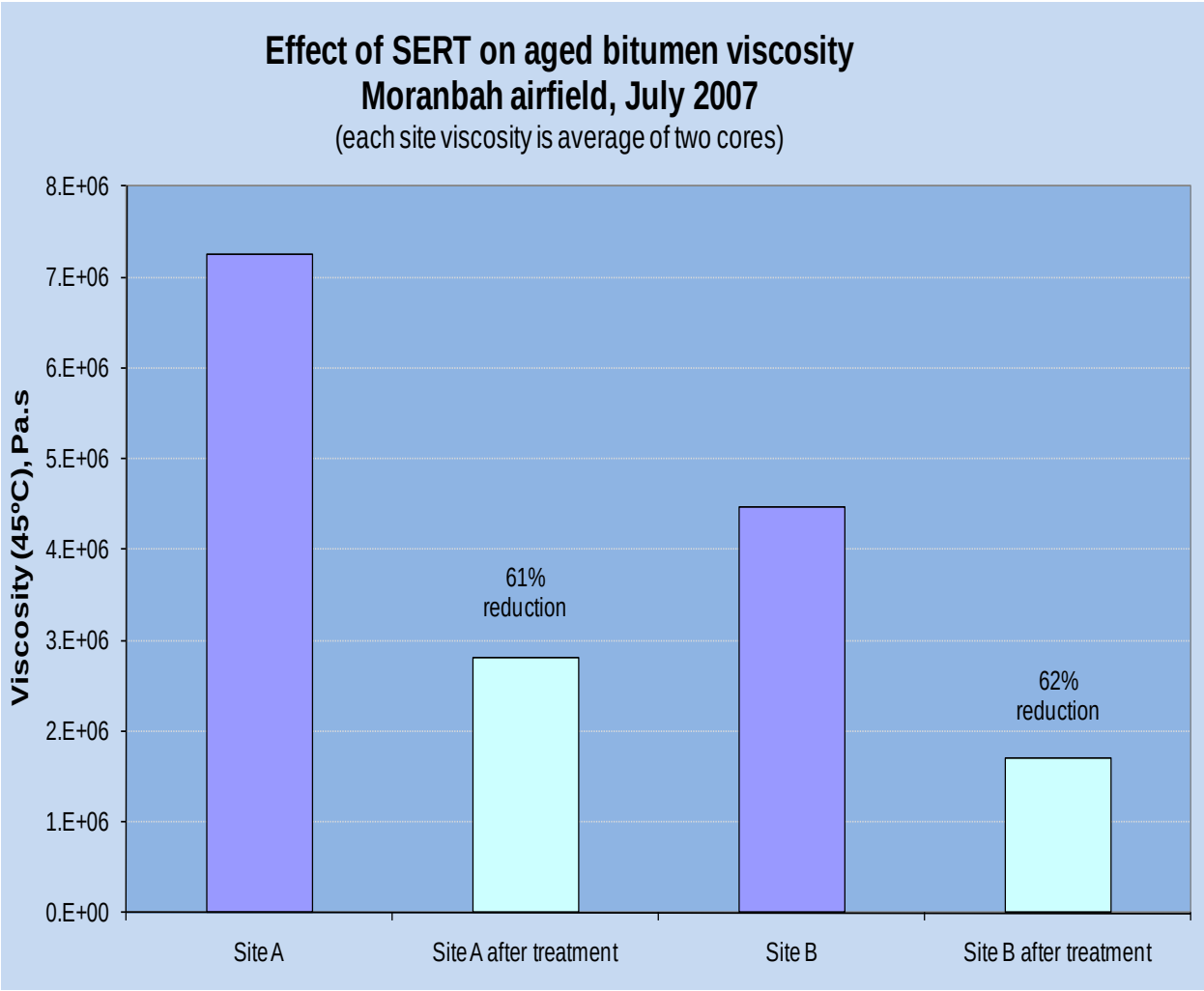
Dry coring before treatment

Moranbah airport pavement before treatment

SERT application by conventional sprayer

SERT application Moranbah airfield

Recovered binder analysis



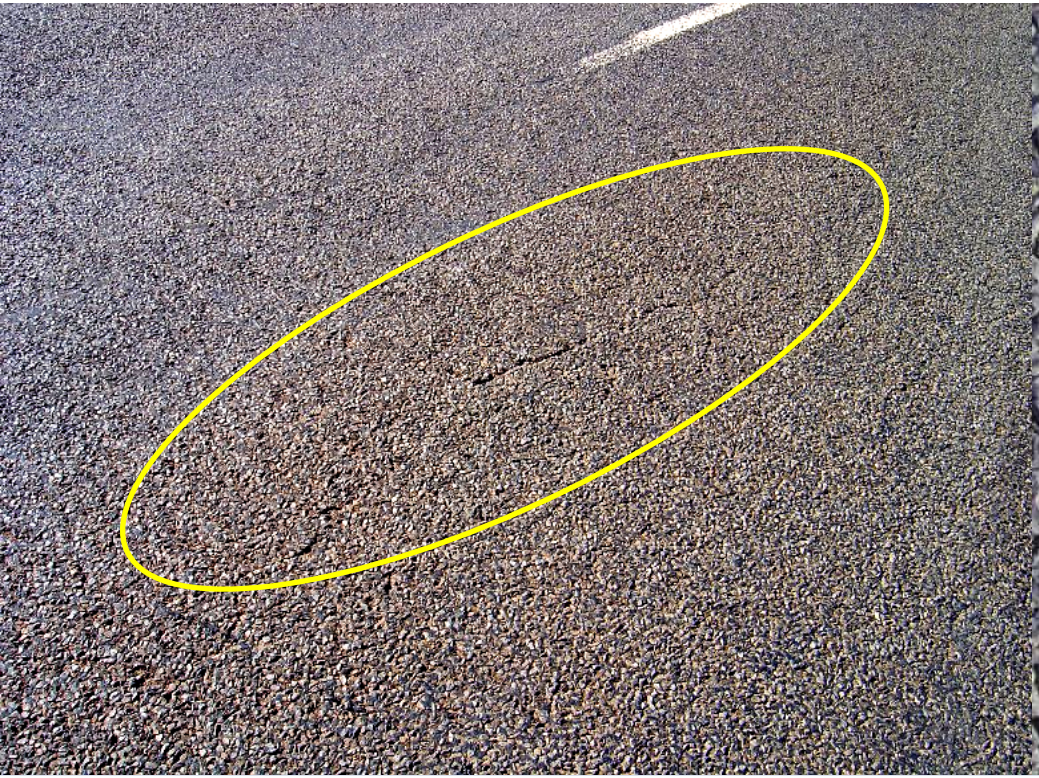
RTA Trials, H7 Mitchell Highway Bourke NSW

- Preliminary site assessment in June, 2009 to identify suitable sections for treatment
- SERT included on 3.5km of some 22km of highway enriched in May 2010
- Treated pavement were predominantly old 14mm seals up to 14 years old
- RTA arranged monitoring of trial areas to assess treatment effectiveness in relation to skid resistance (British Pendulum) and texture

Mitchell Highway Prior to Enrichment
April 2010

Surface condition

Pavement very hungry but basically sound with minor stone loss and occasional longitudinal cracks



RTA Mitchell Highway Trial
April 2010

- 13 -17 year old 14mm seals ≤ 2% stripping
- Pavement 26-42°C
- Air temp. 18-31°C
- Application rate 0.8L/m² @ 40°C or 0.33L/m² residual

Field testing of treated surface

- Surface texture skid resistance by British Pendulum test

Surface texture by sand patch test

SERT crack sealing capacity

Waterproofing effect
Mitchell Highway SERT Trial

Crack after SERT treatment was impermeable

Enlivened binder after treatment

Seal inspected one month after application already showed softening of old bitumen

Binder under old aggregate very lively 8 months after treatment

Sand patch test

Surface Texture Depth, mm			
Segment	**Treatment**	**Before Treatment**	**After Treatment**
3525	SERT	2.4	1.9
3440	CSS/170-60	1.7	1.4
3445	CSS/170-60	2.4	2.1
3650	CSS/170-60	2.8	2.2

Skid resistance

British Pendulum Number				
Segment No.	**Treatment**	**Before Treatment**	**After Treatment**	**After Initial Traffic**
3440	SERT	62	55	61
3445	CSS170-60	72	39	61
3525	CSS170-60	58	32	56
3650	CSS170-60	-	40	60

Friction values recovered rapidly with traffic

Relative cost of treatment options

	Binder Sprayed		
	CSS/170-60	SERT™	7mm Surfix70™ reseal
Residual binder, %	60	40	70
Mixture sprayed, L/m^2	0.6	0.82	1.65
Residual sprayed, L/m^2	0.36	0.33	1.15
Temperature of mixture when sprayed, °C	50-60	40	80

Source: RTA Enrichment Treatment Evaluation, Summary Report June 2010
*Fulton Hogan registered trademarks

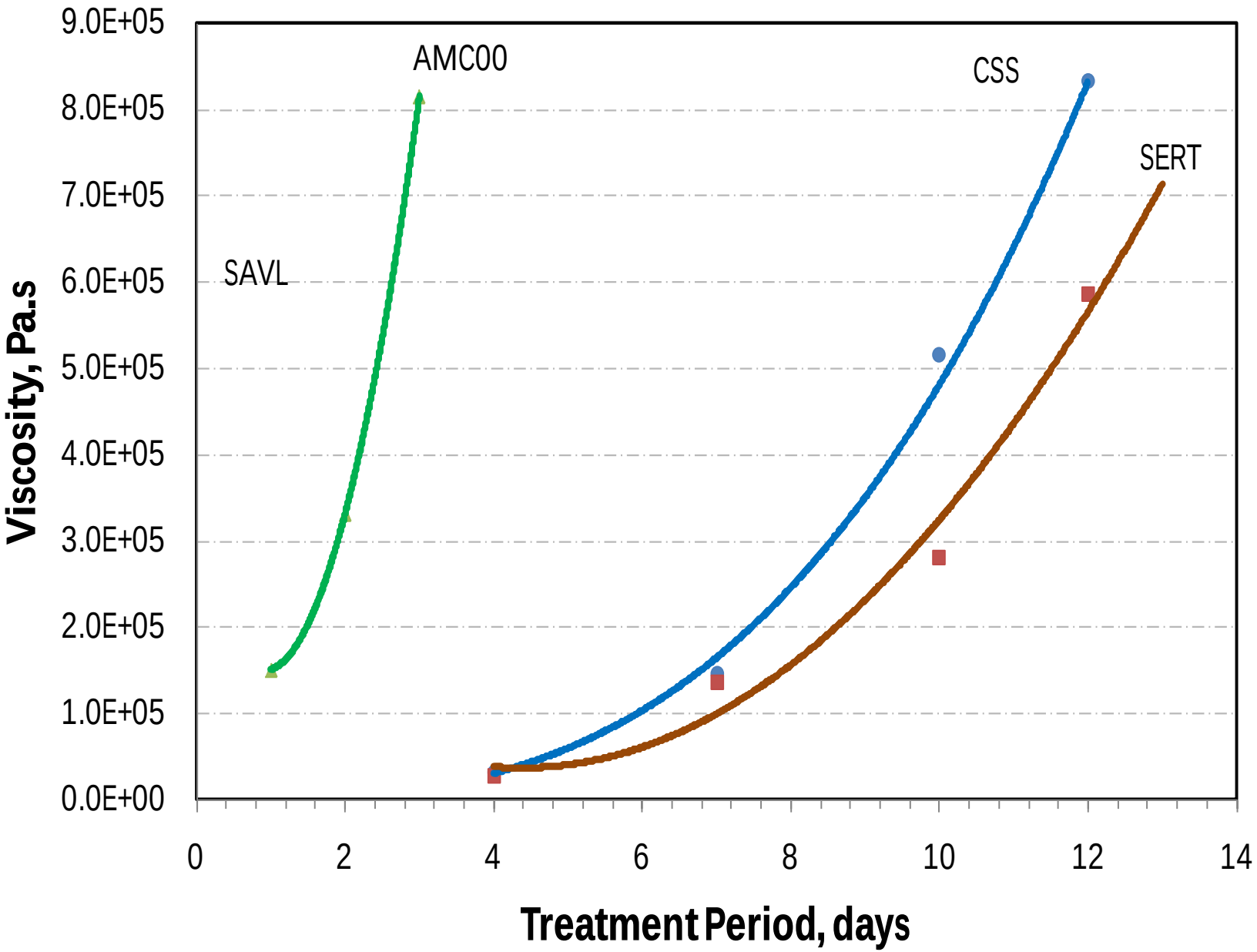
C170 reseal	CSS/17-60 enrichment	SERT	7mm Surfix 70 reseal
Base rate	53%	66%	131%

Note: Costs are relative to the base rate

Comparison of treatments

Treatment	Expected Treatment Life, years		Life required for treatment to be cost effective relative to 7mm C170 reseal in years	
	Minimum	Maximum	Based on min. life	Based on max. life
7mm C170 reseal	5	6		
Enrichment (CSS/170-60)	3	5	2.7	3.2
SERT Enrichment / Rejuvenation	5	7	3.3	4.6
7mm PME reseal	7	10	6.6	7.9

Source: RTA Enrichment Treatment Evaluation Summary Report, June 2010
Pavement and Geotechnical Engineering , Bituminous Surfacing Unit


CSS170, SERT and AMC00 Binders
Exposed to Accelerated Ageing by AS 2341.13
9.0E+05
8.0E+05
7.0E+05
6.0E+05
5.0E+05
4.0E+05
3.0E+05
2.0E+05
1.0E+05
0.0E+00
Viscosity, Pa.s
AMC00
CSS
SERT
SAVL
0
2
4
6
8
10
12
14
Treatment Period, days

Combined rejuvenation and enrichment

- optimises pavement preservation in the one application
- The treatment is suited to both chip seals and asphalt pavements
- Minimal disruption to traffic by treatment
- Rejuvenation of residual binder in a chip seal was evident within one month of application
- Waterproofing was evident in sizeable cracks

Conclusions

- Emulsions currently represent a small proportion all binders used in road construction and maintenance, but have the potential to play a larger role in pavement sustainability
- An improved emulsion enrichment and rejuvenation treatment represents one such example

Thank you

Questions?