

Sprayed Seals

AAPA Tour



Stellenbosch Workshop
5 September 2011

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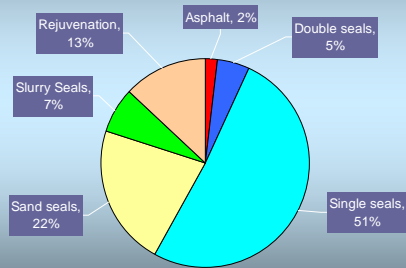
Question 1

- What percentage of the South Africa network is sprayed seals?
- Rural >95%
- Urban – Varies
 - CBDs <1%
 - Larger Metros (Residential)
 - Smaller Towns > 60%

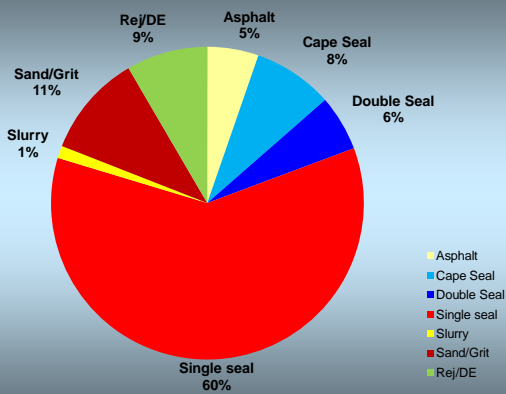
Question 2

- What are the most common seal types, and aggregate sizes? sprayed seals?

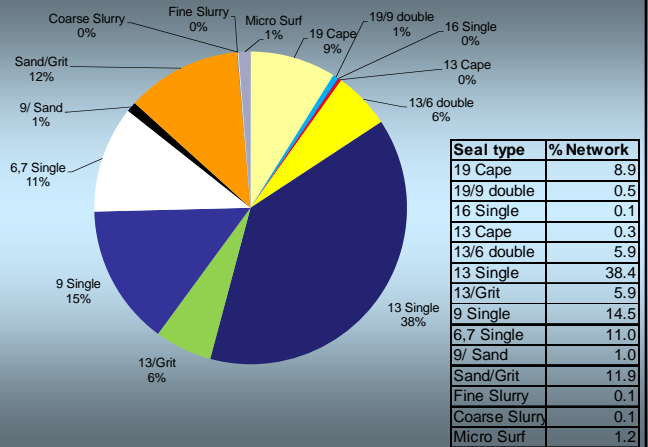
Seal Type Distribution (Western Cape 6 – year average)

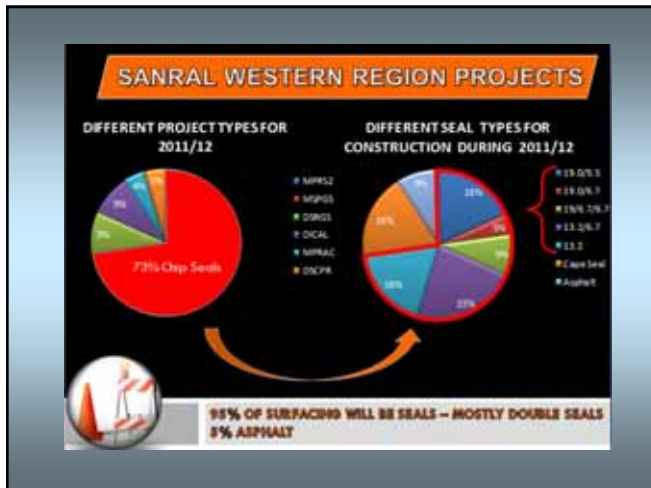
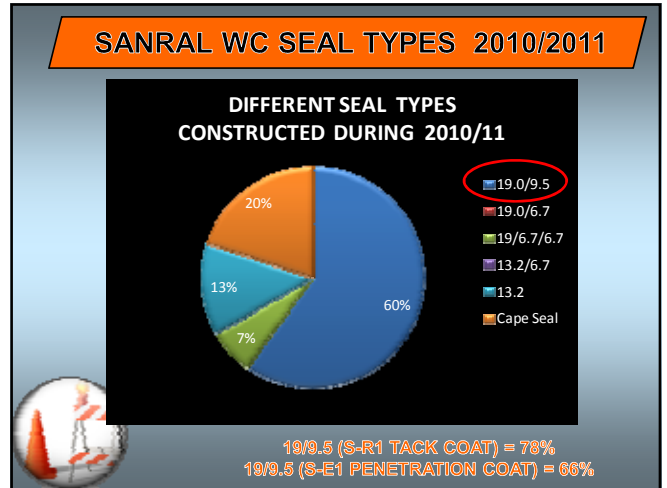
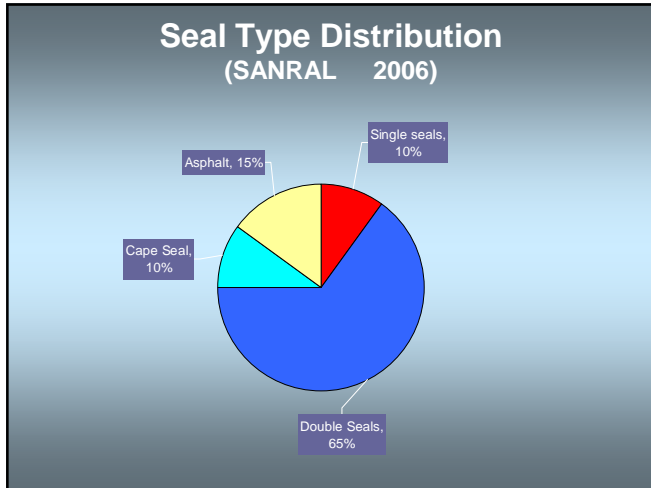


Western Cape - 2011 Last Surfacing

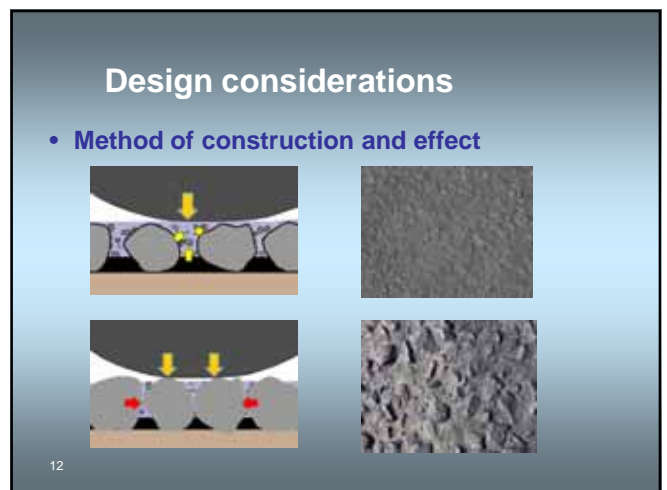
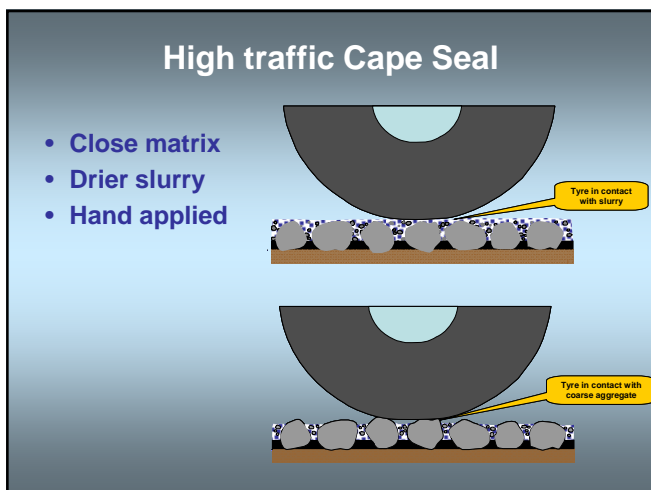


Western Cape - 2011 Aggregate size





- ### Question 3
- How commonly used are Cape Seals, has there application been mechanised, what traffic loading can be accommodated?
 - Western Cape - 8% of network
 - Common as initial seal
 - SANRAL - 10% as initial seal
 - Now – 9.5 CS also as temporary winter seal
 - Prefer not to mechanise
 - Traffic loading –
 - WCPG (Design)
 - Construction seal structure – close with one slurry app
- Mostly used for new construction/rehabilitation as primary seal on top of crushed aggregate base (G1/G2) - (GF)



WCPA material Manual Table 6-34:	
E80 PER DAY (Both directions)	p
<50	0,145
51 - 100	0,140
101 - 150	0,135
151 - 200	0,130
201 – 250	0,125
251 – 300	0,120
>300	0,115

9,5 mm Cape Seal



Question 4

- What standard operations are used in sprayed sealing, are bitumen sprayers uniformly calibrated across the country, are bitumen sprayers certified to use in other jurisdictions?
- Yes – two centres
- Yes – Apply to all areas
- “Bakkie test” standard
- Kobus Louw

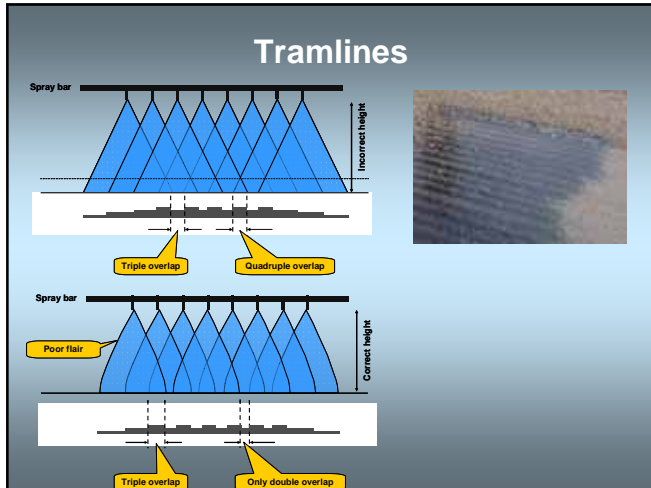
Question 4:

What standard operations are used in sprayed sealing, are bitumen sprayers uniformly calibrated across the country, are bitumen sprayers certified to use in other jurisdictions ?



Transverse distribution





Question 5

- Are bitumen rubber & polymer modified binder sprayers different to normal bitumen sprayers – are they calibrated & certified differently?
- Kobus

Question 5:
 Are bitumen-rubber & polymer modified binder sprayers different to normal bitumen sprayers ? Are they calibrated and certified differently

Types of sprayers in South Africa:

- **Acmar (French)**
- **Bearcat (American)**
- **Etnyre (American)**
- **Rosco (American)**
- **Privately constructed**

SPRAYER CHARACTERISTICS

PRODUCT	NOZZLE OUTPUT (l/min)	SYSTEM PRESSURE (kPa)
Emulsion/Prime	7 – 9	100 - 150
Pen. Bitumen/PMB's	13 – 15	150 – 200
Bitumen-Rubber	35 - 40	350 - 400

Question 8: What range of road grade and modified binders are used in sprayed sealing and what volumes or percentages are sprayed annually ?

BINDER CATEGORY	BINDER TYPES	RELATIVE %
Cutback Bitumen	MC 3000	2
Penetration Grade Bitumen	80/100	3
Polymer Modified	S-E1, S-E2, A-E2, A-P1	48
Bitumen-Rubber	S-R1	5
Bitumen emulsion	CRS 65/70, Anionic Stable Grade 60	35
Latex modified emulsion	SC-E1 and SC-E2, Tack coats for UTFc, Microsurfacing	5
Precoats		2

Question 9:
 Are polymer modified emulsions used in sprayed sealing ? If yes, what are the key motivators and what are the operational and cost implications ?

BINDER	RELATIVE COST (1,0 l/m ² net cold residual)
80/100	1,0
S-E1	1,16
Cationic Spray Grade 70%	1,21
Cationic Spray Grade 70 + 3% SBR	1,43
Cationic Spray Grade 70 + 5% SBR	1,59

Question 6

- How are road surface types selected, is there a local or national norm, what factors are considered when selecting the given surface? Are there particular treatments used for particular reasons?

- Skid resistance / macro texture
- Turning actions
- Traffic volume/distribution - design
- Noise
- Maintenance capability
- Gradient (Drainage/ Gradient)

Q6

Consultants are appointed for investigation, design, tender documentation and site supervision. Therefore, they will list a number of alternatives from which a recommended surfaced treatment will be motivated. Sanral will assess the alternatives based on cost, motivation provided by Consultants, functionality, appropriateness, etc. and compare it with surfacings of adjacent sections on the same route

Question 7

- Is the type of binder to be used included in the selection process or is that determined by the seal design process?

- **SANRAL**

- Not prescribed – CE to motivate
- Condition, Traffic, Climate

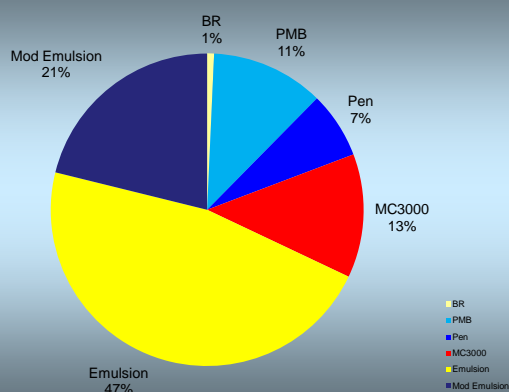
- **Western Cape**

- Recommendation from PMS process
 - Cracking condition
 - Traffic

Question 8

- What range of road grade and modified binders are used in sprayed sealing and what volumes or percentages are sprayed annually?
- **Kobus**

Western Cape - 2011 Last Binder type



Question 9

- Are polymer modified emulsions used in sprayed sealing? If yes what are the key motivators and what are the operational and cost implications?
- **Western Cape**
 - Yes often
 - Climatic conditions and cracking
 - Cost
 - Haulage of water
 - Split application of binder
 - Total (11%- 50% more)

Question 10

- Does the public sector participate in sprayed sealing (percentage private to public)?
 - Western Cape still – Yes
 - Lower order roads

Question 11

- Are binders bought in bulk by the client? If yes how is binder allocated to contracts?
 - No

QUESTION 11:

Are binders bought in bulk by the client. If yes, how is binder allocated to contracts ?

- Exception to the rule for clients to buy bitumen directly from refineries
- Binders are supplied on a first come, first serve basis
- Refiners may ask secondary producers for a forecast of expected demand

Question 12

- Are newer sprayers with different international technologies being used?
- Kobus

QUESTION 12: Are newer sprayers with different international technologies being used ?

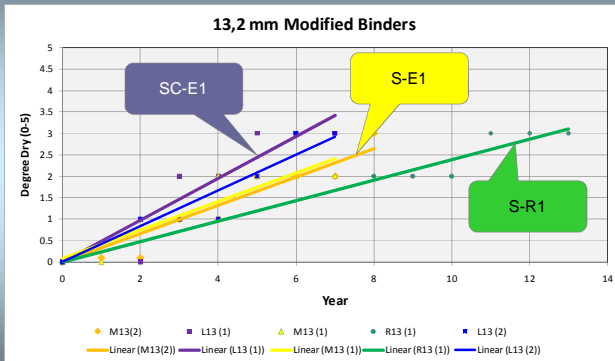
Features:

- Computer controlled binder pump
- Oil jacketed spray bars
- Pneumatically controlled actuators
- No flexible hoses
- Spray bar extends on a rack

Question 13

- Has the comparative performance of the various polymer modified binders and rubber bitumen used in seals been reviewed?
 - Not sufficiently
 - CSIR Rust
 - Crack study (100 – 200 - 300 micron) (Pen,PMB,BR)
 - BR versus Conventional (Old TPA Study)
 - Performance from PMS data
 - WCPG (HDM Calibration sections)

Hardening/ Oxidation (WCPA)



Question 14

- What has been the experience with the performance of SBS seals with the onset of winter?
 - High risk – sensitive
 - Perception – High SBS (S-E2) very sensitive
 - Adhesion to precoated stone ?

Issue 3: Polymer Modified binders

Why is it happening?

- **Poor adhesion**
 - Too low application rates
 - Contact area ?
 - Precoating ?



Question 15/17

- Are performance or functional specifications used in the purchase of surface seals?
- **No not yet**

Question 16

- Are there best practice procedures for
 - surface pre-treatments including rut filling,
 - surface rejuvenation and crack sealing;
 - cutting back of binders,
 - the use of bitumen emulsions;
 - use of self propelled chip spreaders versus spreader boxes,
 - calibration of sprayers,
 - on site blending of bitumen rubber,
 - pre-coating of aggregates, and
 - priming of base courses.
- **Yes to most – but could be updated (TRH3, SABITA Manuals)**

Sprayed Seals

Question 16: Available best practice procedures

- Surface pre-treatments including rut filling (TRH 3)
- Surface rejuvenation and crack sealing (TRH 3 – Manual 20)
- Cutting back of binders (TRH3)
- The use of bitumen emulsions (Manual 30)
- Use of self propelled chip spreaders vs spreader boxes (No)
- Calibration of sprayers (Manual 31)
- On-site blending of bitumen rubber (No)
- Pre-coating of aggregates (Manual 26)
- Priming of base courses (Manual 26)

Question 18

- What allowances are made in the variations of material qualities to achieve optimal use of scarce natural aggregates?
 - Manual 10 - Recommendations
- Is this included integrated into the **seal design** and the performance evaluation?
 - Yes – only in rational design (wearing)
 - Yes – local experiences with quartzitic agg and porius aggregates (Slag & dolerite)
 - Generally NO

Question 19

- What impacts have industrial occupational health and safety requirements had on sprayed sealing operations and materials selection?
 - SANRAL (GF)**
 - Tar based products were banned
 - Consideration given to the use of emulsion where labour intensive work is involved, e.g patching with emulsion treated material.
 - Stricter control measures at sites regarding H&S audits and compliance with legislation

Question 20

- What allowance is made in the design spray rate to differentiate between the performance properties of the different binders?
 - Performance ?
 - Prevent chip loss/ bleeding (Envelope)
 - Risk of attracted traffic – minimum
 - Crack reflection – Maximum
 - Conversion factors (TRH3 + recommended changes)

S-E1 Conversion

S-E1 ADJUSTMENT (Conventional to modified binder)			
Traffic (ELV)	Single seal	Double Seal	Split application double seal
< 5000	1.3	1.1	1.2
5000 - 20000	1.2	1.0	1.1
> 20000	1.1	1.0	1.0

S-E2 Conversion

S-E2 ADJUSTMENT (Conventional to modified binder)			
Traffic (ELV)	Single seal	Double Seal	Split application double seal
< 5000	1.4	1.2	1.3
5000 - 20000	1.3	1.1	1.2
> 20000	1.2	1.0	1.1

S-R1

S-R1 ADJUSTMENT (Conventional to modified binder)			
Traffic (ELV)	Single seal	Double Seal	Split application double seal
< 5000	2.0	1.8 ?	- ?
5000 - 20000	1.9	1.7 ?	- ?
> 20000	1.8	1.6 ?	- ?

Question 21

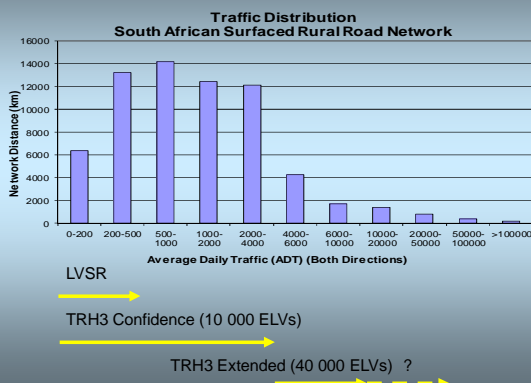
- What tests and acceptance criteria are used for granular base courses prior to sealing ie % dry back, embedment etc
- Density
- 50% of OMC (Prime/ Seal !!)
- Curing periods for pre-treatments – COLTO
- No Specs on embedment
 - but does indicate problem in Crushed stone base
 - Test result interpretation !!!

Question 22

- What is the maximum traffic volume and other limiting factors used for spray seals selection ?
- TRH3 – Research base – 10 000 ELVs
- Extrapolation – 40 000 ELVs
- Experience/ Trials – no real limits but dependent on sub-strate softness

Question 23

- How do they address seal failures ie bleeding, flushing,
 - Dry aggregate layer before reseal
 - Roll in precoated aggregate
- stripping,
 - Cat spray grade cover spray
 - Back chipping
 - Precoated Grit
- ravelling etc?
 - Rejuvenation spray
 - MC 300 + Grit
 - Slurry



Question 24

- How is funding for sealing and maintenance procured?
 - WCPG/ NamRA – PMS Strategic analysis
- How are sites for sealing selected?
 - WCPG/ NamRA - Tactical analysis, Reseal Need Index
- What process is used to rank these sites?
 - WCPG – RNI + Panel Inspection
 - Nam RA – Remaining Life to RNI = 50 + traffic

Question 25

- What percentage of roads is resealed annually?
 - Used to be 7- 12% (Ave 10%)
 - Back Log
- What is the life expectancy of seals in South Africa?
 - Average 8 – 15 years (Average 10 years)
 - Thin initial seals = 3 years

Issue 1: Preventive Maintenance

- **Road Authority A**
 - 6500 km surfaced
 - Cycle used to be 7 – 12 years
 - Now: Seal age 76% > 12 years
 - No reseal since 2005

PAVED ROADS - SEAL AGES

>20	30%
17-20	22%
13-16	24%
9-12	16%
6-8	6%
<5	2%

Expenditure on road infrastructure

KILOMETRE ROADS RESEALED FROM 1986

55

Issue 1: Preventive Maintenance

Road Authority B – 6200 km

ROAD AUTHORITY B: Reseal km per year

ROAD AUTHORITY B: Last Seal Age (% of Network per category)

42% under 10 years
87% under 20 years

Issue 1: Preventive Maintenance

Road Authority C – 6100 km surfaced

- Seal age (40% older than 10 years)

LEGEND:

0 - 5 years	■
5 - 10 years	■
10 - 15 years	■
15 - 20 years	■
20 - 25 years	■
25 + years	■

Question 26

- To what extent are geotextile seals used? Are there any guidelines for the use of geotextile seals in areas of high stress?
 - Geotextile patching – High
 - Full-scale reseal – Low
 - Guidelines – TRH3

Question 27

- What properties are specified for sealing aggregates? Is a minimum average least dimension required?
 - Hardness (ACV/ 10% FACT)
 - PSV
 - Durability
 - Grading (Single sized aggregate)
 - Dust
 - Flakiness
 - ALD
 - Binder/ Aggregate adhesion

Question 28

- Bitumen rubber seals using high binder application rates have been reported on (Jooste K & van Zyl GD 2010). How are these seals performing? Under what conditions are they used?
 - Extremely well, especially 19/9.5
 - Very high application rates 4 – 5 l/m²
 - Mainly holding actions

Slurry: Question 1

- **What is the primary use of slurry seals?**
Urban networks? Rural network?
- **Urban**
 - Overlays – Slurry & Microsurfacing
- **Rural**
 - Texture treatments
 - Cape Seals
 - Shape correction
 - Long-term overlay not common anymore

Slurry Seals

Question 2:

- * Are slurry/microsurfacing used as rut filling and overlays ?
- * Are they used to improve skid resistance ?
- * What life expectancy is achieved ?
- * What mix design methods are used ?
- * Any lessons learnt or mix design guidelines ?
- * Are there performance records ?

Slurry: Question 2

- Are slurry / micro-surfacing used as rut filling and overlays? **Yes, but agg grading different**
- Are they used to improve skid resistance? **No**
- What life expectancy is achieved? **Depend on pavement condition and components (2 – 10)**
- What mix design methods are used? **Man 28**
- Any lessons learnt or best practice guides? **Man 28**
- Are there performance records? **- ???**

Slurry: Question 4

- Is the equipment used of a similar type / standardised?





Slurry Seals

Question 4: Are slurry/microsurfacing sold under brand names? Are they included in a HAPAS type certification process?

Slurry: Question 5

- Are they using PMB emulsions in their slurry seals if so what kind?

TG 1 Guideline

POLYMER MODIFIED EMULSIONS							
Property	Unit	Quantity		Class			
		SC-E1	AC-E3	SC-E1	SC-E3		
Slinder content (min)	%	62-65	62-65	65-68	70-73	65-68	70-73
Saybolt Furl viscosity @ 50°C	SPs	NA	NA	51-200	51-400	51-200	51-400
Residue on sieving	75µm sieve	≤ 0.1	≤ 0.1	≤ 0.1	≤ 0.1	≤ 0.1	≤ 0.1
	150µm sieve	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5
Particle charge	+	-	-	-	-	-	-
Sedimentation after 60 rotations	ml	NA	NA	NA	NA	NA	NA
Recovered binder residue							
Softening point	°C	≤ 48	≤ 55	≤ 48	≤ 48	≤ 50	≤ 50
Elastic recovery @ 15°C	%	≥ 50	≥ 55	≥ 50	≥ 50	≥ 50	≥ 50
Force ductility @ 5°C	N	NA	NA	report	report	report	report

TEXTURE TREATMENT

- **When required**
 - Very coarse/ varying texture
 - Existing texture (consider existing seal type)
 - Alternative texture treatments
 - (6,7mm stone seal, grit seal, fine slurry)
 - Concerns (e.g. time to stabilise)
- **Warning**
 - Not on bleeding/ tacky surfaces



Impact of no texture treatment



Pre-treatment ignored



Rejuvenation: Question 1

- **Is surface enrichment a common practice?**
 - Yes – for RA still active

Rejuvenation: Question 2

- **What is the primary motivation for using surface rejuvenation?**
 - Dry/ Brittleness of binder
 - Sensitivity to aggregate loss
 - Availability of voids

Rejuvenation: Question 3

- **Is it included in seal design and application?**
 - Not in design of seals
 - As selection of pre-treatment
 - Trial recommendations
 - Typical (0.8 – 1.0 l/m² 50/50 Stable grade emulsion)

Rejuvenation: Question 4

- **What selection / performance criteria are used in choosing a surface enrichment product?**
 - Traffic accommodation
 - Available voids

DE required



Rejuvenation: Question 5

- **What application rates are used? What are the costs / area of the products used?**
 - DE – 0.8 – 1.0 l/m² (50/50 60% Stable Anionic)
 - Rejuvenator e.g. MSP3 0.4-0.5 l/m²
 - Costs

Surface Rejuvenation

Question 5: What application rates are used? What are the costs/area of products used

Answer:

* Application rates – 0,4 to 0,5 l/m²

* Costs around Cape Town - R5-00/m²

* Costs in Namibia – R6-00 to R7-00/m²



Rejuvenation: Question 6

- What binder types are used for surface enrichment?

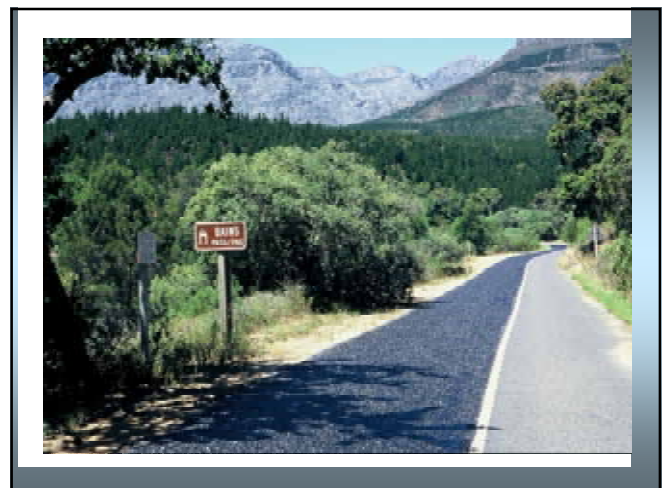
Rejuvenation: Question 7

- Are special commercial products / petroleum product formulations used for rejuvenation?

Surface Rejuvenation

Question 7: Are special commercial products/petroleum product formulations used for rejuvenation ?

- **Specific brand names being used**
- **Usually inverted emulsions containing some aromatic oil**





Rejuvenation: Question 8

- Is there a formal design process?
- **No**
 - Typical
 - Trial

Rejuvenation: Question 9

- What are the life cycle cost benefits of surface rejuvenation?
 - Effect seal life increase 3-4 years

Cover Spray

- Prefer conventional Cat spray grade
- Low/ undiluted
- Time to settle



Cat Spray grade on old seal



Polymer Modified



Rejuvenation: Question 10

- What rejuvenation treatments are used on asphalt surfaced pavements where the environment rather than loading is the major influence on deterioration? (eg low volume residential streets in cities)
 - Anionic Stable emulsion
 - Other experiments (Stability problem) – CSIR doc

Surface Rejuvenation

Question 10: What rejuvenation treatments are used on asphalt surfaced pavements where the environment rather than loading is the major influence on deterioration? (eg. low volume residential streets in cities)

- Rejuvenation treatments not normally used on hot-mix asphalt surfaces
- Also not recommended in residential areas

THE END