Sprayed Seals for High Volume Roads
Current Best Practice

SANRAL Workshop
15 August 2011

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Acknowledgements

• **Papers & presentations**
  - D Judd
  - H Thompson
  - K Jooste
  - Holtrop
  - R Clayton

• **Discussions (18)**
  - Road Authorities
  - Consultants
  - Contractors
  - Suppliers
Introduction

- Development op seal design
- Traffic spectrum & Seal types
- Sensitivities and Typical problems
- Principles towards “Best Practice”
  - Single Seals
  - Double Stone Seals
  - Cape Seals
Seal sensitivity
SEAL DESIGN

PRINCIPLES TO DETERMINE BINDER APPLICATION RATE

VOID LOSS DUE TO AGGREGATE WEAR

TEXTURE FOR SKID RESISTANCE

MAXIMUM VOIDS TO BE FILLED

VOID LOSS DUE TO EMBEDMENT

TOTAL VOIDS

ALD

MINIMUM VOIDS TO BE FILLED
Binder application

Maximum for target texture

Minimum

Binder application

Traffic

High

Low

Max
Min

30%
Traffic Distribution
South African Surfaced Rural Road Network

LVSR

TRH3 Confidence (10 000 ELVs)

TRH3 Extended (40 000 ELVs)
Seal Type Distribution
(Western Cape 6 – year average)

- Single seals, 51%
- Sand seals, 22%
- Slurry Seals, 7%
- Rejuvenation, 13%
- Asphalt, 2%
- Double seals, 5%
Seal Type Distribution
(SANRAL 2006)

- Single seals, 10%
- Double Seals, 65%
- Cape Seal, 10%
- Asphalt, 15%

Double Seals, 65%
Cape Seal, 10%
Asphalt, 15%
Single seals, 10%
13.2 mm Stone

Note: Risk - Too much binder for target texture, yet too little to prevent whip-off

ALD 8 mm SINGLE

Traffic (elv/lane/day)

Corrected Ball Penetration (mm)

Nett cold binder (litres/m²)

Minimum

0.5 mm

0.7 mm

1.0 mm

Minimum

1.5 2.0 2.5 3.0 4.0

Corrected Ball Penetration (mm) 0.0 - 1.0

Correct Embedment (mm)

ALD 8 mm SINGLE

Traffic (elv/lane/day)

Corrected Ball Penetration (mm)

Nett cold binder (litres/m²)

Minimum

0.5 mm

0.7 mm

1.0 mm

Minimum

1.5 2.0 2.5 3.0 4.0

Corrected Ball Penetration (mm) 0.0 - 1.0

Correct Embedment (mm)
Note: Practitioners recommend a minimum of 1 litre per square metre binder application.

ALD 11 mm SINGLE

16 mm Stone
Embedment (mm)

Traffic (elv/lane/day)

ALD 16 mm DOUBLE

Corrected Ball Penetration (mm) 0.0 - 1.0

0.7 mm

Nett cold binder (litres/m²)

Minimum

1.0 mm

1.5

2.0

2.5

3.0

4.0

Corrected Ball Penetration (mm) 0.0 - 1.0

0.7 mm

Nett cold binder (litres/m²)

Minimum

1.0 mm

Note: Risk - Too much binder for target texture, yet too little to prevent whip-off
Key aspects of good performance

• **Selection of Seal type and binder**
• **Design (Uniformity)**
  - Texture and pre-treatment
  - Substrate softness
  - Traffic and movements (dual direction)
  - Micro climates
  - Stockpiles, aggregate properties and impact
• **Attention to detail during construction - QA**
Pre-treatment
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
DE required
Micro climate effects
QA on Site

• More important than design !!!

• Trials
  - NB - Stone matrix
  - Adjustments

• Equipment

• Process
  - Preparation e.g. string line, traffic accom, etc
  - Rolling
  - Joints
Equipment checks
Binder application
Tramlines

Spray bar

Incorrect height

Triple overlap
Quadruple overlap

Spray bar

Correct height

Only double overlap
Poor flair
Nozzle angles
Nozzle alignment

Observed
Transverse distribution
Joints

Irregular joint
Longitudinal Joints

• Damage caused
  - Chip spreader wheel running on bitumen
String line essential
Transverse Joint Fattiness

Observed

Cause
Transverse Joints

Observed

Recommended

August 16, 2011
Joints – Fish plate

Spray bar

Correct height

Fish plate

In theory

In practice
Joint overspray

Uniform Triple overlap

Joint overspray 4/3
Cover spray on joint
Aggregate application
Precoating

• Wet or dry? (not water)
• **Wet precoat (typically within 24 hours)**
  - **Benefits:**
    - Easy flow of aggregate through chip spreader gates
    - Increase area of adhesion
  - **Risks**
    - Highly sensitive to rain during first night after application
    - Keep closed for longer
• **Dry precoat (typically more than 4 days).**
  - **Benefits**
    - Less sensitive to early rain after construction
  - **Risks**
    - Clogging of smaller aggregate sizes resulting in poor distribution of aggregate
Precoating
Aggregate Application

- Trials
- Shape of aggregate
- Purpose of seal
Over application
Rolling
Bond Strength
Potential embedment

Orientation

Rocking movement - meniscus creep

Increase binder contact area
Stone Packing/ Matrix
Cover Spray

- Prefer conventional Cat spray grade
- Low/ undiluted
- Time to settle
Polymer Modified
• Which seal are you aiming for?

double seal (1.5)

double seal
19/9,5 Sensitivities

- Shape of aggregate
- Geometry – Open versus tight packing

- Too low binder application
- Distribution of binder (tack, penetration, cover)
19/9,5 Practical hints

• Changing the geometry of the seal through heavy steel wheel rolling on the 19,0 mm aggregate

• Steel wheel rolling after application of the 9,5 mm aggregate, followed by application of a cationic spray grade emulsion, either undiluted or a maximum dilution to 60% emulsion and 40% water at a rate of minimum 0,8 l/m².

• Both actions as described above
19/9,5  Practical hints

- Use of **hot modified binders** in both the **tack** coat and **penetration coat**
- Precoating both aggregate sizes
- Allow 48 hours before opening to traffic
- Only open when road surface temperature increased to above 25 °C (preferably 30 °C)
- Closure at night during first week if low temperatures (< 5 °C) are expected
\textbf{Principles}

- Create voids to allow binder movement
- 19 + dry 6,7 + 6,7
- Design ALD 1 + ALD 2
Split Application Double Seal

• **Sensitivities**
  - Geometry (not open)
  - Binder types (NB flow into dry layer)
  - Minimum and maximum binder per layer
  - Spread rate of dry 6,7 mm and adhesion of penetration coat to 19 mm aggregate

• Construction process
  - Rolling
19/6/6 Open
19/6/6 Tight packing
High traffic Cape Seal

- Close matrix
- Drier slurry
- Hand applied
THE END