Using 'Insitu Foamed Bitumen' and 'Triple Blend' additives to rehabilitate fatiguing cement treated pavements in Fitzroy District

Bruce Highway – Yeppen South Project

Damian Volker and Chris White | Department of Transport and Main Roads
The bigger picture

Existing pavement rehabilitated, two lanes in the Southbound direction.

New Q100 elevated 1.6 km long bridge, two lanes Northbound direction.
About the new bridge

Underside of deck will be 600mm above Q100 flood level

Height varies

Natural surface

11.5m between kerbs

Proposed Bruce Highway

Northbound

Wearing surface

Deck

Girders

Headstock

Columns

Pilecap

Piles

Approx 3.5m above existing highway level
Pavement challenges in Queensland

- Expansive soils
  - Shrink / swell effects of expansive support conditions are very damaging to our roads
- Flooding
- Ageing network
  - with fatiguing cement treated pavements
- Increasing traffic volumes.

Information supplied by the Department of Natural Resources, Queensland and adapted from the Atlas of Soils, CSIRO.
Bruce Highway Yeppen South Project
ticks all our pavement challenges boxes
Yeppen South rehabilitation profile

50 mm asphalt surface course
50 mm asphalt binder course
300 mm foamed bitumen base
320 mm triple blend subgrade
Embankment material
Natural ground

Triple blend subgrade
What is triple blend stabilisation?

• A triple blend stabilisation is a subbase or subgrade treatment which is typically carried out on materials of medium plasticity by incorporating lime, cement and fly ash.

• Triple blend stabilisation will:
  - increase the California Bearing Ratio (CBR) value
  - reduce the plasticity index
  - reduce permeability (reduces moisture sensitivity)
  - reduce shrink swell characteristics.

• Triple blend stabilisation is enabling the foundation improvement of a larger variety of subbase and subgrade materials in Queensland.
Yeppen South pavement investigation
### Triple blend stabilisation – Determining blend ratios

<table>
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<th>Lime</th>
<th>Cement</th>
<th>Fly Ash</th>
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<tbody>
<tr>
<td>LS &lt; 6%</td>
<td>30%</td>
<td>40%</td>
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<tr>
<td>LS &gt; 6%</td>
<td>40%</td>
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- Common blend ratios adopted in Queensland
Triple blend laboratory mix design

Unconfined Compressive Strength (UCS)

Percentage Triple Blend Additive

(Lime 40% / Cement 30% / Fly Ash 30%)
Bruce Highway – Yeppen South

4% Triple Blend

Insitu Density x Depth x % additive = rate kg/m2
2100 kg/m3 x 0.35 m x 0.04
= 29.4 kg/m2

Lime
(40% portion)

Lime = 11.80 kg/m2

GB (50/50)
(60% Portion)

GB (50/50) = 17.60 kg/m2

17.6kg/m2 GB Cement (50/50)

4% Triple Blend

11.8kg/m2 lime
Yeppen South rehabilitation profile

50 mm asphalt surface course
50 mm asphalt binder course
300 mm foamed bitumen base
320 mm triple blend subgrade
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Foamed bitumen base
Binder requirements

Secondary additive: Hydrated Lime – 1.5%

Primary additive: Class 170 Bitumen – 3%
Inclusion of water and bitumen foaming agent
What is foamed bitumen?

Foamed bitumen is produced in the expansion chamber.
Characteristics

- Non-continuously bound (spot welds)
- Millions of individual elastic points with solid
- Fine particles immobilised.
Benefits of foamed bitumen stabilisation

- Foamed bitumen improves the stiffness and load bearing capacity
- Provides longer working times during construction
- Better fatigue resistance than using a cement stabilised base
- Offers better resilience to flooding (reduces moisture sensitivity)
- Offers better resilience to flooding (reduces moisture sensitivity)
- Moisture resistant pavement
- Using lime as a secondary additive
- Provides longer working times during construction
- Strong and flexible pavement
- Reduces shrinkage cracking
- Reduces shrinkage cracking
Materials placed prior to foamed bitumen:

- 150 mm Type 2.1 new quarry material: 50%
- 120 mm Reclaimed cement treated material: 40%
- 30 mm Triple blend stabilised subgrade: 10%
Triple blend subbase construction
Completed triple blend subgrade layer
Yeppen 4% Triple Blend L/C/F 40:30:30 Subgrade: lab vs field UCS results

- UCS lab Design
- Ch:114545 O/S 4.0m L
- Ch:115100 O/S 0.8m R
Foamed bitumen base construction
30 mm tuck into the triple blend layer

Before

300 mm
Foamed Bitumen

320 mm
Triple Blend Subgrade

350 mm

After

270 mm

30 mm
Yeppen South rehabilitation profile

50 mm asphalt surface course
50 mm asphalt binder course
300 mm foamed bitumen base
320 mm triple blend subgrade
Embankment material
Natural ground

Geotextile seal
Yeppen South rehabilitation profile

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Asphalt surfacing
Bruce Highway Yeppen South Project

Gravel savings by reusing 40% cement treated base: $125,000
Hydrated lime savings: $18,500

A saving of $107 k/km, or $10.25 /m²
Recycled 100% existing cement treated base using Foamed Bitumen. Therefore reduction in the secondary additive – lime.
Bruce Highway Gentle Annie
Triple blend subgrade + foamed bitumen base

Total savings $122,000 + $38,500 = $160,500

A saving of $160.5 k/km, or $13.50 /m²
Summary

• These innovations and savings arise from rigorous laboratory and field research, and justify ongoing research.

• This ensures that the implementation of responsible innovation is based on sound laboratory research.
Thank you