Bitumen Supply and Performance

17th - 23rd November 2010

REAAA New Zealand
The Bitumen Supply Line
Supply Overview

• The world uses approximately 100 Million tonnes of bitumen annually

• New Zealand uses approximately 160,000 tonnes of bitumen annually (0.16% world demand)

• The NZ refinery at Marsden Point supplies approximately 120,000 tonnes of bitumen annually

• The NZ short fall of bitumen is approximately 40,000 tonnes annually which has to be imported
Bitumen Market Sectors

- Asphalt: 25%
- Bitumen Sealing: 75%
The NZ Bitumen Ports

NZ Bitumen Facilities:

- 10 Port locations
- 13 Terminals
- 7 Import Capable locations
- 6 Terminal Owners, including:
  - Suppliers/Contractors
  - Terminal Owner-Operators
  - NZ Refining Company
• The Napier plant is typical of the port plants around NZ
• Bitumen is pumped from wharf to plant by the vessel
• The plant extracts bitumen from bulk tanks into smaller service (day) tanks
• The plant has two load out gantries
• The pictured gantry loads remotely
• Strict health and safety procedures are followed during all operations
• Temperature/volume adjustment are automatically controlled
• All bitumen is sold by weight
Key Supply Characteristics

• Main North Island terminals have significant storage capability
• Smaller ports with limited storage
• Very seasonal demand
• Single coastal vessel
The Kakariki

- 44,000 gross tonne vessel serving all NZ ports
- 2,600 tonnes of bitumen on each voyage / 2 Grades
- The Ports of Napier and Mt Maunganui can use more than 2,600 tonnes of bitumen in one week during the sealing season
Implications for Security of Supply?

• Limited ability to build inventory at the smaller ports during the off-season

• Limited coastal shipping can lead to constraints in the peak season

• Additional coastal shipping would likely be under-utilised and very costly

• Imports continue to play a key role
Implications on Safety & the Future

• Significant Health & Safety requirements
• Kerosene or “cutback”
• Handling temperatures between 140° to 180°C
Implications on Safety & the Future

- The world is heading to alternatives of hot cutback sealing & hot mixed asphalt
- Emulsions
- WAM
Bitumen Specifications & Performance
• Bitumen Specification
  – Penetration grading
  – Viscosity grading
  – PG grading

• Bitumen Performance
Bitumen Specification

- THE specification for Bitumen in New Zealand is the **NZTA M/1**.
- Major requirements are:
  - Penetration @ 25ºC
  - Viscosity @ 60ºC
  - Viscosity @ 135ºC
  - Aging tests.
25°C
Penetration at 25°C

It measures the hardness or softness of bitumen by measuring the depth in tenths of a millimeter to which a standard loaded needle will penetrate vertically in 5 seconds.
60/70 Grade Bitumen
Penetration

Stiffness

High

Low

25°C

Low Temp

High Temp

Temperature

80/100 Bitumen

80

100

Penetration

Stiffness
New Zealand

- **Temperature**
  - Low Temp
  - High Temp

- **Stiffness**
  - High
  - Low

- **Penetration**
  - 70
  - 60

- **Viscosity**
  - 60°C
  - 190

- **60/70 Bitumen**

Temperature vs. Stiffness graph showing the relationship between temperature and stiffness for different bitumen types.
Australia

Temperature

Stiffness

Penetration

Class 170 Bitumen

Viscosity

High

Low

Low Temp

25° C

60° C

High Temp

Penetration

Viscosity

Class 170 Bitumen

Australia

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USA

PG 67-22 Bitumen

Creep Stiffness

Dynamic Sear

High Stiffness

300 MPa

1.0 kPa

Low Stiffness

Low Temp -22°C

Temperature

High Temp +67°C

Downer 
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USA

Creep Stiffness

Stiffness

High Temp

Temperature

Dynamic Shear

Low Temp

-20°C

+67°C

Low

High

300 MPa

PG 67-22 Bitumen

1.0 kPa
Temperature vs. Stiffness for PG67-22 Bitumen

- High Temp: +67°C
- Low Temp: -18°C

Dynamic Shear
Creep Stiffness

USA

1.0 kPa
Temperature

Stiffness

PG67-16 Bitumen

USA

Creep Stiffness

Dynamic Shear

High Temp

Low Temp

High

Low

Stiffness

300 MPa

1.0 kPa

-16°C

+67°C

Temperature
Bitumen Performance
“Ultimate” Performance Tool

- Dynamic Shear Rheometer (DSR)
  - Determines the performance of a binder across a range of temperatures and traffic frequencies (speeds)
  - Determines the Complex Modulus (Stiffness) & the Elastic/Viscous balance of a binder.
80/100 Results - Stiffness

Graph showing the relationship between Modulus (Stiffness) and Temperature (°C) at 1 Hz. The graph indicates a decrease in Modulus as temperature increases.
60/70 Results - Stiffness

![Graph showing the relationship between Modulus (Stiffness) and Temperature °C at 1 Hz. The graph compares 80/100 ex NZRC and 60/70 ex NZRC materials.]
40/50 Results - Stiffness
NZRC - Import: Stiffness

Temperature ºC

Modulus (Stiffness)

1.000E8

1.000E7

1.000E6

1.000E5

10000

1000

100

80/100 Import

80/100 NZRC
NZRC - Import: Visco-Elastic Balance
How is this of use?

• In selecting the best binder for any given application

• In understanding the relative performance benefits arising from alternative or high performance binders. Eg PMB’s
Polymer Binder - Stiffness

- Modulus (Stiffness)
- Temperature (°C)

Graph showing the modulus (stiffness) of polymer binders at different temperatures. The graph includes lines for 80/100 ex NZRC, 40/50 ex NZRC, and 60/70 ex NZRC.
What does this tool do for us?

• We can compare bitumen from different sources and understand their relative performance.

• We can understand the benefits of PMB’s across all temperatures and traffic speeds.

• We can monitor the quality of manufactured PMB.
Questions?