A Safe, Sustainable, Long Life, Low Noise Surface

SaferRoads2017
5th International Conference

Alabaster (NZTA)
Forrest/Waters (Fulton Hogan)
Herrington (Opus)

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Outline

- Customer Focus
- Background to EMOGPA
- Safety
- Sustainability
- Noise
- Where are we at?
- What is in it for the Customer

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The Customer Focus

- Our customers want safe, sustainable and quiet road surfaces.
- Currently about 6.4% of the network is OGPA.
- Will likely double the amount in next 5 years.
- Around $\$20/m^2$- $\$30/m^2$ to replace?
- The average life for OGPA is 7.2 years.

- Safe and Quiet but not Sustainable or Long Life

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Why does OGPA fail?

Herrington, P.R., Reilly, S., Cook S. 2005. Porous Asphalt Durability Test. Transfund New Zealand Research Report 265.

- Most common form of distress is loss of chip from the surface (fretting and ravelling)
- Caused by embrittlement through reaction with atmospheric oxygen.
- Durability depends on
  - oxidation resistance of the binder
  - binder film thickness
  - aggregate grading
  - and percentage of air voids.

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OECD Long Life Surfacings Study

Epoxy Modified Bitumen - the only existing product with the potential to extend surface lives.

Properties-:

- Stiffer (higher modulus) at service temperatures, with greater load spreading ability
- More resistant to rutting, low temperature crack initiation, and surface abrasion from tyre action, even after oxidation
- More resistant to fatigue cracking (although the benefits are less marked at higher strain levels)
- Less susceptible to water induced damage
- **More resistant to oxidative degradation**.

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Epoxy bitumen - where does it come from?

- Developed by Shell in 1960s for airfields
- Main use is on very large difficult orthotropic steel bridge decks
- First application, on the San Francisco Mateo Bridge (California, United States), met performance requirements for over 40 years.
- Two part system:
    - Part A - epoxy resin formed from epichlorhydrin and bisphenol.
    - Part B - fatty acid curing agent in approximately 70 penetration grade bitumen

Part A Part B

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NZ Input to OECD Study

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CAPTIF Test

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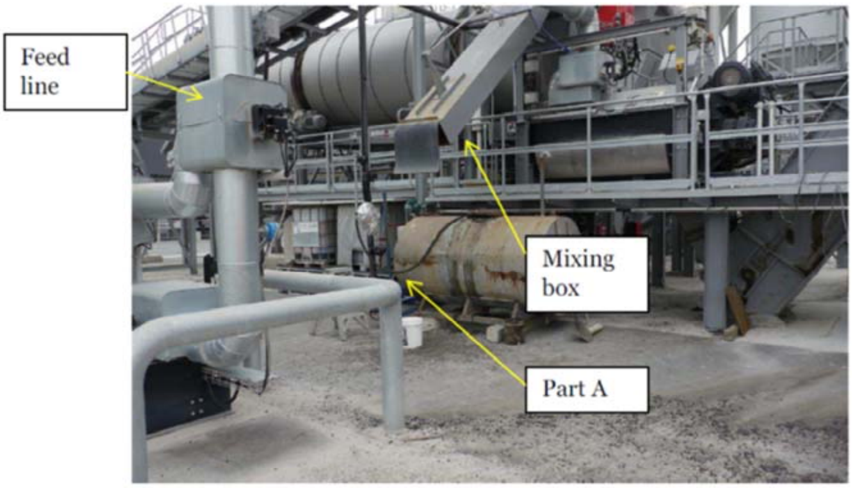
Modifications to Asphalt Plant



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Laying 100% EMOGPA 2007

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Pros and Cons of EMOGPA

Pros

- higher modulus with greater load spreading ability
- Resistant to rutting, and low temperature cracking
- Resistant to fatigue cracking
- Less susceptible to water induced damage
- More resistant to oxidative degradation

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Cons of EMOGPA

Cons

- Risk of curing during processing
- Changes required to normal processing operations
- Cost
- Normal cost of OGPA is $25/m^2
- EMOGPA cost is approx double

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NZ implementation

- Reducing costs by diluting the Epoxy Binder
- 25% EMOGPA lost all the rheological properties
- **But** maintained bulk of the oxidation properties
- Estimated life – 40+ years
- Costs of $6/m^2$ extra for 25% epoxy bitumen
- Break-even is 11 years.

- But room to improve as designs based on conventional OGPA thinking!.

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Safety Considerations

- Concern that polishing over extended period would form a slippery surface

To combat this we only specify EMOGPA on low stress sites

- ie only in T/10 Site Cat 4 and 5. Straight roads with no events (0.40 and 0.35)
- Analysis has found that standard aggregates tend not to polish down below 0.40

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Optimizing Sustainability

- Looked at optimizing sustainability with
  - less binder and
  - less aggregate (ie more air voids).

- Cost wise - 5.5% binder content, 25% epoxy bitumen mix (20% air void) = 100% epoxy bitumen with a 1.75% binder

- Unfortunately, 1.75% mix is dry and friable by hand
- Satisfactory 20% air void mixes need 2.25% binder
- High air void (~30%), low binder content mixes showed the coating of the aggregate at 2.25% binder was better

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Sustainability Options

Name	% Air void	Binder % Mass	Binder Type (% by wt)
Control	~20%	5.5%	100% 80-100 bitumen
25% epoxy	~20%	5.5%	25% Type V, 75% 80-100
100% epoxy	~30%	2.25%	100% Type V
100% epoxy	~30%	3%	100% Type V

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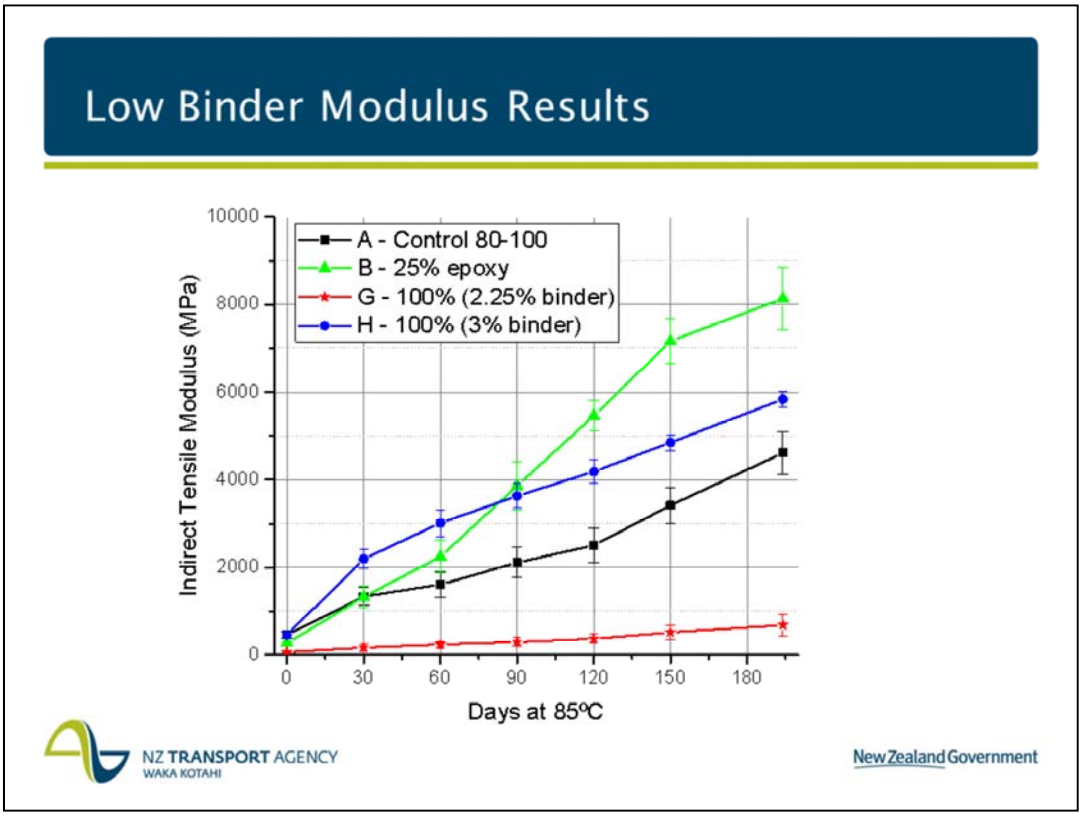
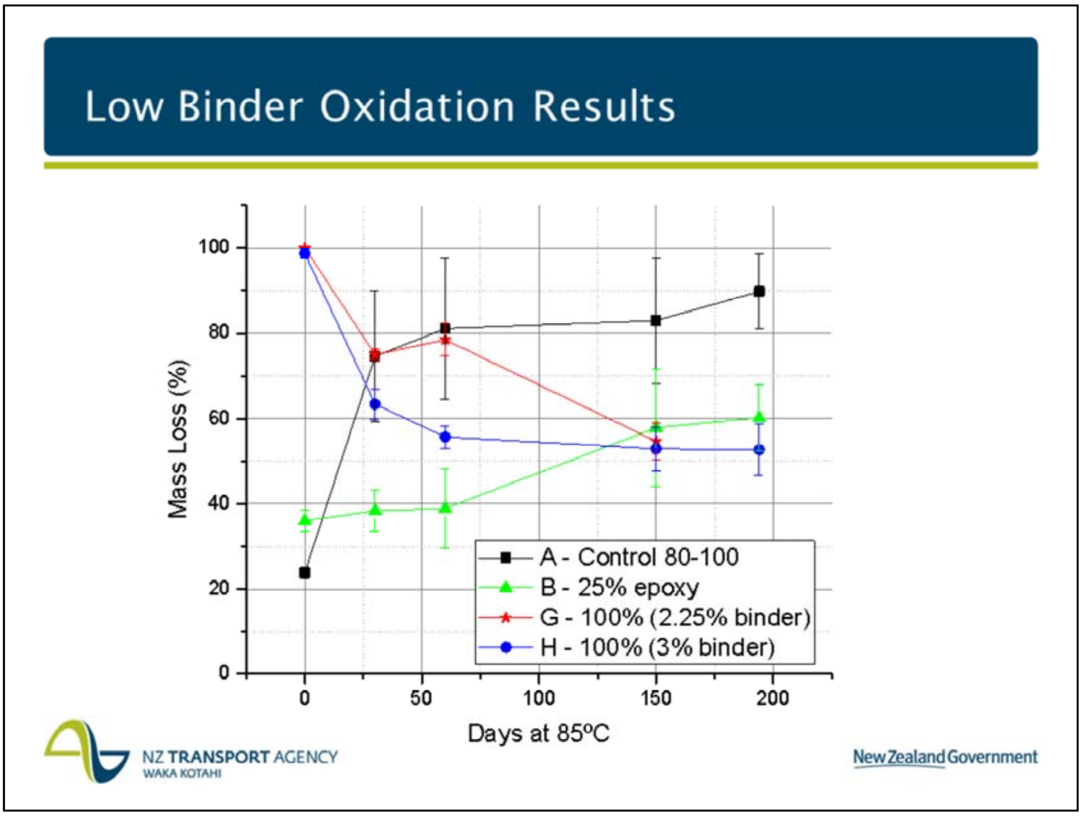


Manufacturing needs an extra small heated Tank (or an Intermediate Bulk Container (IBC)) with Part A feed into the Part B/local Bitumen that is in main AC plant tanks. Static inline mixing is working well. (ie a pipe with bends designed in it). Can be a temporary or permanent change in operation of AC plant.



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Sustainability Conclusions

To be practical rapid curing of the high void mixes needed. Ie

- use of higher mixing temperatures
- in-situ infrared heating or
- changes to the epoxy binder formulation
- use of curing accelerators

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Where are we at?

- Contracts in Auckland, Hamilton, Wellington and Christchurch on "Roads of National Significance"
- Contracts with Fulton Hogan, Downers and Higgins
- Completed:
- Fulton Hogan - SH16 Auckland (Lincoln Rd, Te Atatu and St Lukes), SH1 Wellington (N2AQ). SH1 Hamilton (Cambridge BP).
- Downers - SH1 Christchurch, (Sawyers to Groynes and Memorial Ave).

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Where are we going

- New IR QA test working well.
- Working with Environmental Team to optimise acoustics (of all OGPA).
  - Smaller chip better than more voids
  - Positive traffic control for a day after opening?
- New Epoxy Binders being approved.
- Developing lower binder/ higher void solutions?
- Working on Epoxy Binder Chipseals
- Need check on old pavements before use

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What's in it for the Customer

Customer Focussed, Collaborative and Curious work delivering a surface that is:

- Safe
- Sustainable
- Low Noise
- Long Life

- A future OGPA budget 1/6 of current level

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