A Convenient Truth : Glass Asphalt

Meda Sicoe, Fulton Hogan WA

Colin Leek, City of Canning WA

So you like a drink?

- It takes approximately 16MJ to make a kg of glass
- A stubby weighs 200g and takes 3.14MJ to make
- To put this in human terms a 75 kg person would need to:
  - Walk 25.8km
  - Cycle 11.1km
  - Swim 2.5km
  - Climb 3.1km

Why we do the things we do

- Why do I want to put glass in asphalt?
- I don't
- So why do I?

We do the things we do because:

- I do it because
  - there is no glass reprocessing in WA
  - there are vested interests in making new glass bottles rather than refilling
  - to truck glass to Adelaide consumes more energy than it saves
  - to rail glass to Adelaide is energy efficient (just), but it needs to be clean
  - reusing the glass in asphalt saves using new aggregates
  - by not using new aggregates we save habitat

Glass stockpile used in 8 months

WAste in WA

- DEC has a long winded definition of waste
  - For the purpose of these guidelines waste may mean one or more of the following:
    - any substance that is discarded, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment;
    - any discarded, rejected, unwanted, surplus or abandoned substance;
    - any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, reprocessing, recovery, or purification by a separate operation from that which produced the substance

Is glass a waste?

- Used glass is not a waste
- Used glass is a resource
  - (but we cant call it a resource cause it don't attract the landfill levy if we do)
- To not re-use glass is a waste

Glass asphalt : History

- Glass asphalt was originally developed in 1960's in Europe and USA as an alternative to landfill disposal of recycled waste glass.

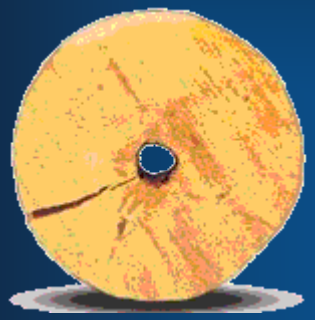
- Glass asphalt is similar with the conventional dense graded asphalt, except that 5%-15% (up to 40% in USA) of the aggregates are replaced by crushed glass

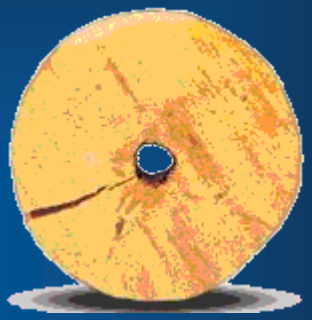
- Low to heavy traffic applications, for residential streets, distributor and industrial roads etc.

- In and out of fashion due to limited industry interest, higher glass transport costs, insufficient infrastructure for collection etc.

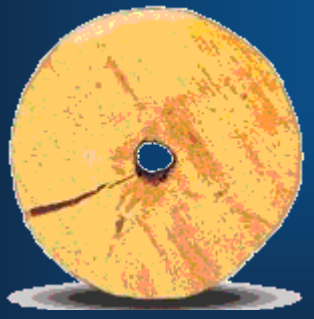
Glass asphalt – we are not reinventing the wheel

Reinvention





Refinement



Glass asphalt – WA experience

- In 2002 Fulton Hogan (then Pioneer Road Services) performed the first trials with asphalt including waste coloured glass for City of Canning, local council in Western Australia.

- Since then Fulton Hogan WA produced approximate 100,000 tonnes of glass asphalt for local council: City of Canning, Town of Vincent and Shire of Kalamunda.

- The asphalt tested for Particle Size Distribution, bitumen content, mechanical and volumetric properties met the requirements of the Local and State authority specifications (IPWEA & MRWA)

- Field trials involving the WA Police Department and Main Roads WA showed that the skid resistance and braking time of the 10 mm Glass asphalt is slightly better than the control dense grade mix.

Glass asphalt – WA experience

Ranford Rd, City of Canning trials

Glass asphalt – WA experience

Ranford Rd, City of Canning - Skid resistance trials

Section	Surfacing	Condition	Tyres	Time	Trial	Speed	Displacement	Coefficient of friction	Average Coefficient
1	10mm SMA	Overcast/ Dry	Bridgestone P205/65 R15	09:58-10:08	1	47.9	14.4	0.6	0.604
					2	48.6	14.7	0.608	
					3	50.2	16	0.605	
2	10mm SMA	Overcast/ Dry	Bridgestone P205/65 R15	10:14-10:25	1	50.3	14.8	0.623	0.634
					2	47	13	0.62	
					3	50	12.9	0.66	
3	7mm SMA	Overcast/ Dry	Bridgestone P205/65 R15	10:35-10:45	1	46.2	11.1	0.712	0.714
					2	51.5	13.9	0.712	
					3	49.9	12.8	0.718	
4	10mm DGA	Overcast/ Dry	Bridgestone P205/65 R15	10:53-11:00	1	46.6	11.1	0.754	0.759
					2	48.9	12.3	0.757	
					3	49.3	12.3	0.766	
5	10mm DGA with recycled glass	Overcast/ Dry	Bridgestone P205/65 R15	11:04-11:15	1	48	11.1	0.795	0.778
					2	47.6	11.3	0.769	
					3	51.5	13.2	0.77	

Glass asphalt – WA experience

The Fulton Hogan WA initiative with regards to glass asphalt development and production involved the following stages:

- Source a constant supply of waste mixed colour glass.
- R&D and feasibility studies regarding the compatibility of glass added to granite asphalt mixes, construction of a glass crushing plant, production and supply of glass asphalt
- The purchase and installation of a glass crusher
- Design of dense graded asphalt mixes with 5 -10% incorporated glass
- Trials with Local Councils
- Marketing for Industry acceptance

Glass asphalt – WA experience

- The original primary crusher was replaced with a small cone crusher which decreased the downtime and reduced the wear.
- At the end of the conveyor from the primary crusher, the material is screened, diverting less than 5mm material to the storage bin and the plus 5mm to a secondary crusher.
- The 5mm trommel screen has been replaced with a 8 x 4 precision screen to allow all year production

Glass asphalt – WA experience

Before

After

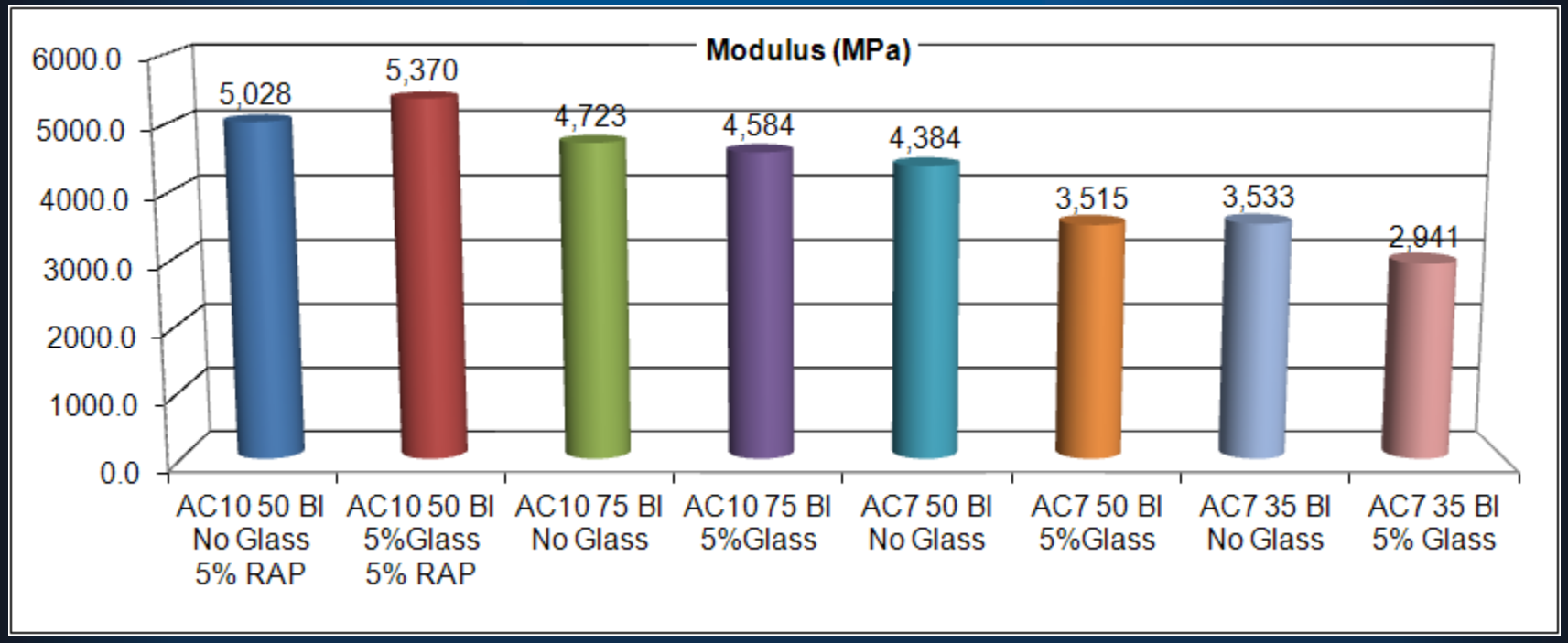
Glass asphalt – WA experience

Production trial mixes

Trial mix size	Trial mix grading	Marshall blows	Application	Glass added
10 mm	Dense	50	medium traffic	none
10 mm	Dense	50	medium traffic	5%
10 mm	Dense	75	heavy traffic	none
10 mm	Dense	75	heavy traffic	5%
7 mm	Dense	50	light traffic	none
7 mm	Dense	50	light traffic	5%
7 mm	Dense	35	light traffic	none
7 mm	Dense	35	light traffic	5%

Glass asphalt – WA experience

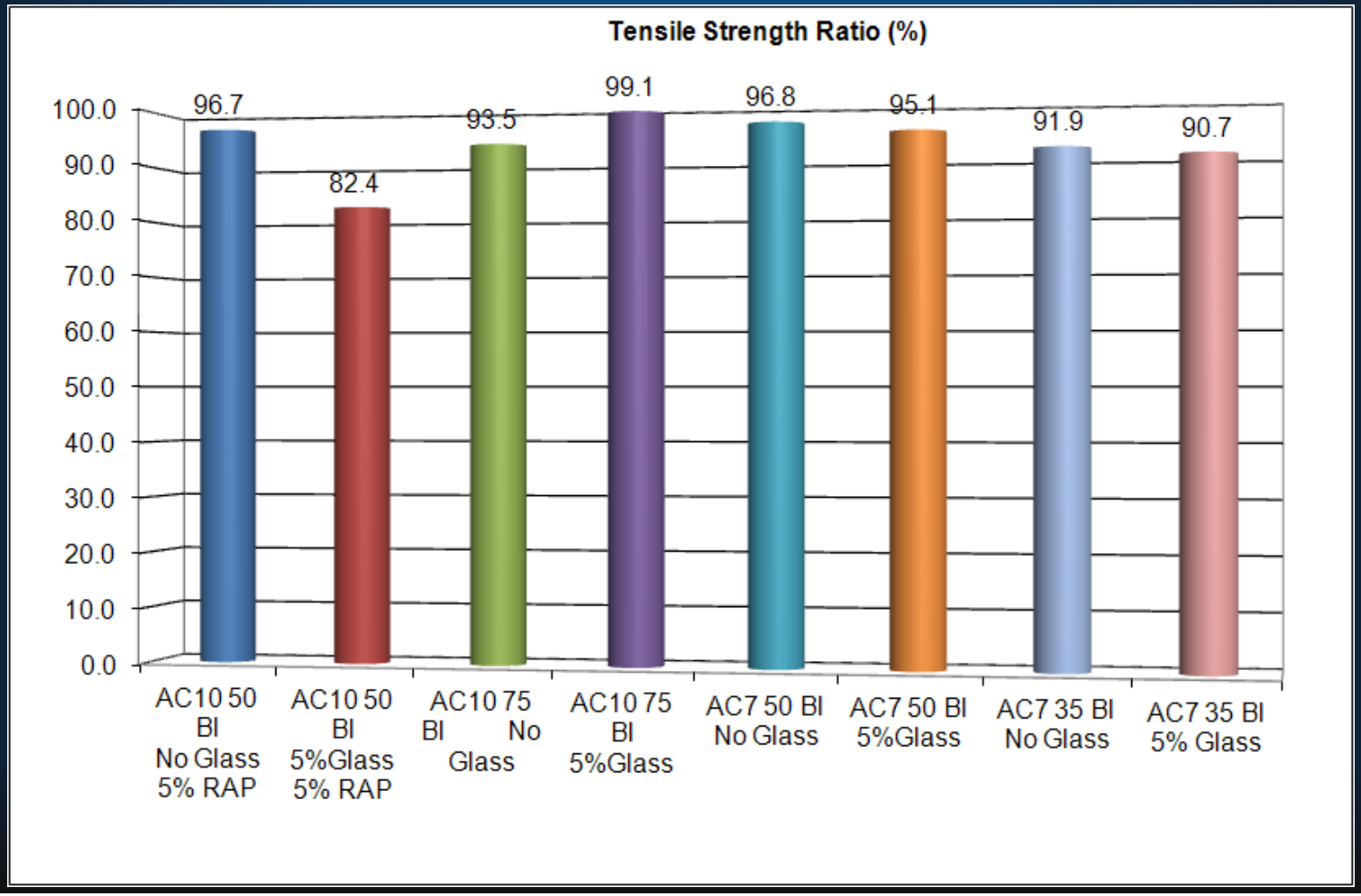
Indirect Tensile Resilient Modulus - AS 2891.13



Glass asphalt – WA experience

Tensile Strength Ratio - AGPT /T232

Main Roads Specification Min 80%



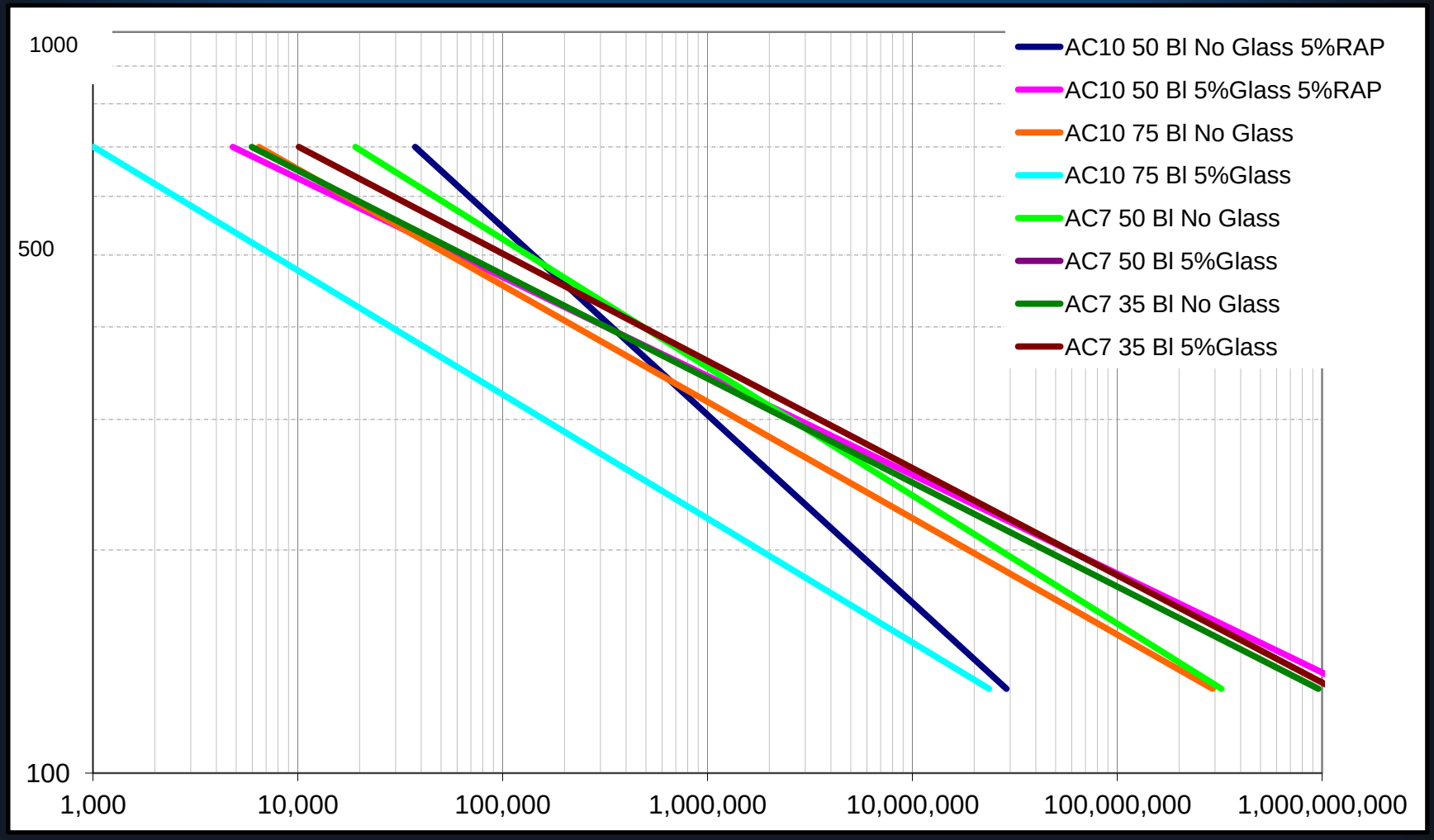
Glass asphalt – WA experience

Fatigue - AGPT/T233

Nominal size (mm)	Marshall blows	Glass added	K	n	R^2	Cycles to failure	
					Applied strain	130me	700me
10	50	None	10076	3.95	1.00	2.87×10^7	37,365
10	50	5%	2168	7.50	1.00	1.46×10^9	4,810
10	75	None	2778	6.36	0.99	2.91×10^8	6,465
10	75	5%	2226	5.98	1.00	2.36×10^8	1,008
7	50	None	3853	5.78	1.00	3.21×10^9	19,113
7	50	5%	2719	6.66	0.96	6.16×10^8	8,375
7	35	None	2373	7.12	0.96	9.58×10^8	5,956
7	35	5%	2658	6.91	0.98	1.14×10^9	10,103

Glass asphalt – WA experience

Fatigue - AGPT/T233



Glass asphalt – WA experience

Conclusions and going forward

- Test results have shown that the addition of 5% waste glass to dense graded asphalt mixes has low impact on the asphalt long term properties, particularly when used in residential streets or roads with larger volumes of light traffic.
- Glass is a recyclable product, and only that portion of glass that cannot be economically or efficiently utilised in the remanufacture of new glass should be used
- Local government should be encouraged to use recycled products wherever possible.
- Reuse of glass also saves on landfill space, which is also a valuable commodity and should be reserved for only those materials that cannot be recycled.

Waste reduction hierarchy

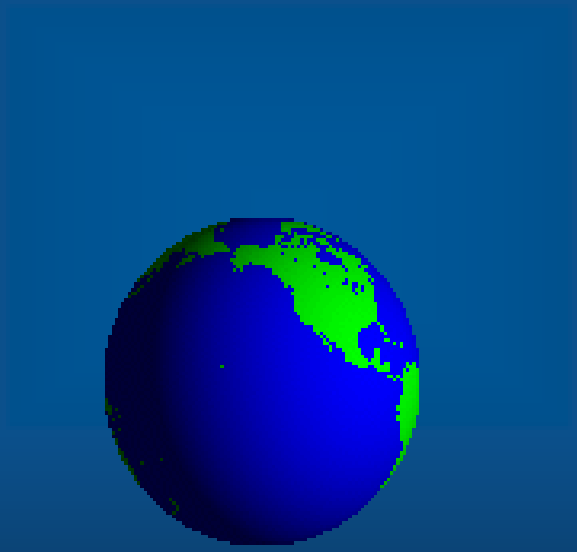
- We should:
  - avoid wherever possible (ie do we really need it)
  - reuse as much as possible
  - recycle back to original use
  - recycle for a new use
- But we should never throw it away

How should Government react

- Local, State and Federal Governments should:
  - specify recycled content
  - include in tender selection criteria
    - commitment to R&D
    - commitment to use of recycled products
    - commitment to minimising environmental footprint in manufacture
  - be prepared to pay the real cost

Glass asphalt – WA experience

Fulton Hogan will continue the research into glass asphalt in order to develop a larger data base and give more certainty to any possible performance advantages or disadvantages to adding glass to asphalt.



Thank you