Case Study: Australia's First use of Net-Zero Bitumen – M1000 at Moreton Bay

Project Partners	
Puma Bitumen	Innovation Lead & Binder Supply
Austek	Asphalt Producer and Asphalt Contractor
Moreton Bay	Asset Owner

Background

Asphalt is a core material in road construction, yet it is the major contributor to Global Warming Potential (GWP) due to the use of Bitumen and high energy demands to produce the asphalt. Biogenic Bitumen modifiers are an innovate technology to reduce the carbon footprint of the asphalt product; by targeting the, the Global Warming Potential of asphalt can be significantly reduced without any detrimental effects on performance.

Achieving net-zero for bitumen is technically significant. It represents a key step towards meeting net zero targets demanded of the industry from the Paris Agreement and will be a key step towards decarbonising road infrastructure.

Challenge

Moreton Bay were supportive towards exploring a net zero option, and were open to trailing a product that could meet this requirement.

The key challenges were:

- Producing a net zero M1000 bitumen product that meets AS2008 specifications
- Develop and manufacture the M1000 at scale
- Utilise enough biogenic material into the bitumen to achieve net zero

Figure 1 Net Zero M1000 Bitumen

Quality

To meet the performance requirements of AS2008 M1000:

- The full AS2008 M1000 specification had to achieved
- Every large-scale batch was tested to ensure compliance
- Terminal manufacturing procedures were closely monitored to ensure accurate modification

Innovation

Puma Bitumen developed CarbonBind M1000, a modified binder that incorporates a large content of renewable, modified plant-based materials that have already sequestered CO_2 from the atmosphere. This innovation:

- Reduced carbon intensity by 592.5 kg CO_2 per tonne of binder
- Matched the performance of standard M1000 binders to AS2008 standards
- Required no plant modifications, special handling, or changes to asphalt mix designs

Manufacturing took place at Puma Bitumen's Bulwer terminal, using refined tank farm dosing systems and supported by a NATA-accredited laboratory for rapid quality control.

An example of the AS2008 test reports for the CarbonBind M1000 are shown below:

Table 1, Results of CarbonBind M1000 Laboratory and Large Scale Formulations

Analysis	Method	Units	Min	Max	Laboratory Blend	Terminal Manufactured
Report Number					25-5269	24-5495
Dynamic Viscosity @60°C	AS/NZS 2341.2	Pa.s			911	843
Dynamic Viscosity @135°C	AS/NZS 2341.2	Pa.s		1.5	0.715	0.636
Penetration of Residual Bitumen	AS 2341.12	pu			53	60
Dynamic Viscosity @60°C after RTFO	AS/NZS 2341.2	Pa.s	3500	6500	4590	4300
Mass Change after RTFO Treatment	AS/NZS 2341.10	% mass	-0.6	0.6	0.2	0.1
Penetration at 25°C after RTFO Treatment	AS 2341.2	pu	26		36	40
Density	AS 2341.7	Kg/m^3			1020.5	1014.5

All results for CarbonBind M1000 are compliant to AS2008 specification for M1000.

Implementation

A total of 43 tonnes of CarbonBind M1000 was produced and supplied to Austek who manufactured ~860t of asphalt for a dedicated intersection of Moreton Bay pavement works.

- Laboratory and field testing confirmed compliance with AS2008 specifications

Figure 2, CarbonBind M1000 in Moreton Bay

Results

Environmental Impact

- 20,000 kg CO_2 saved through binder substitution alone
- Stored biogenic carbon directly within the pavement
- Supported verifiable sustainability reporting with LCAs and EPDs

Operational Impact

- No additional testing, delays, or equipment changes required

Industry Impact

- First Australian use of net zero biogenic binder
- Demonstrated that sustainable binders can be commercially viable at scale

Key Learnings

- Sustainability goals can be achieved without sacrificing technical performance or cost efficiency.
- Co-production of standard and sustainable binders allows for direct performance benchmarking, aiding future adoption.