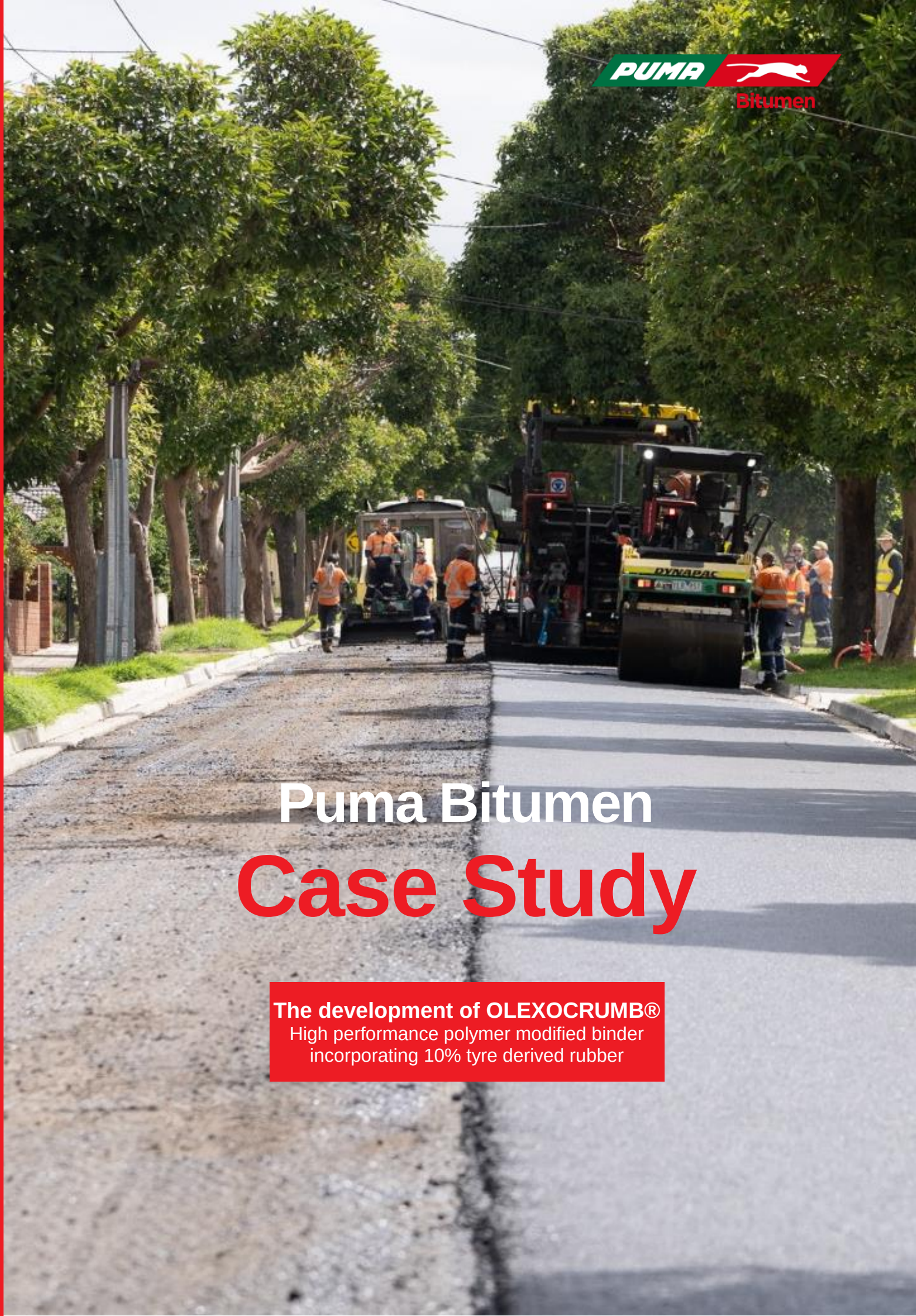

Puma Bitumen

Case Study

The development of OLEXOCRUMB®
High performance polymer modified binder
incorporating 10% tyre derived rubber

Background

OLEXOCRUMB® from Puma Energy incorporates 10% recycled tyre rubber and was specifically designed and formulated to comply with existing trusted Austroads polymer modified binders (PMB) specifications. The rubber provides elastic properties to the binder, representing a high value application of this waste material. The product also includes warm mix additive allowing asphalt to be produced at lower temperatures, reducing carbon emissions and fuming on site.

This case study follows the development of OLEXOCRUMB® from its conception in Puma Energy's Global Bitumen Technology Centre, to its full introduction as part of a trial organised by Transport for Victoria in March 2020 on public roads in Melbourne.

The Challenge

The inspiration to develop OLEXOCRUMB® came from the challenge society and governments are facing in finding a beneficial use of waste tyres. In Australia, the equivalent of 56 million passenger tyres reach their end-of-life each year. Many of these waste tyres end up in landfill, or are burned as fuel for heavy industry. The large stockpiles of waste tyres that exist in many locations form a fire hazard and are notoriously hard to extinguish. There is a growing desire to find local opportunities to put waste tyres to beneficial use.

One high-value application of this waste rubber is as an elastomeric modifier for bitumen in roads. The inclusion of recycled tyre rubber allows roads to be built with increased flexibility and durability.

Crumb rubber asphalt binder technologies already available in the market have inherent properties which currently prevent wider usage of them. For example, they contain a significant amount of residual rubber particles, which interfere with the volumetrics in asphalt mix designs. These binders also do not comply with current standard binder specifications, which introduces a measure of perceived risk and uncertainty on their performance. Therefore, the objective in the development of OLEXOCRUMB® was for Puma Energy to design a binder that complies with existing PMB specifications and has close to no residual rubber particles. This would allow the binder to be used more widely by the industry as a straight substitute for conventional PMB binders, in existing asphalt mix designs.

Development

OLEXOCRUMB® was developed at Puma Energy's state-of-the-art Global Bitumen Technology Centre in Altona, which boasts the latest test equipment for bitumen and asphalt materials. It was here where Research and Development team started to develop a hybrid binder that combines tyre-derived rubber with styrene-butadiene-styrene (SBS). This hybrid binder performs as strongly as conventional PMBs. By meeting all criteria in the performance specifications for trusted PMB grades, road agencies and end users will be given the confidence to adopt the OLEXOCRUMB® binder and fundamentally reduce the environmental impact of end-of-life-tyres.

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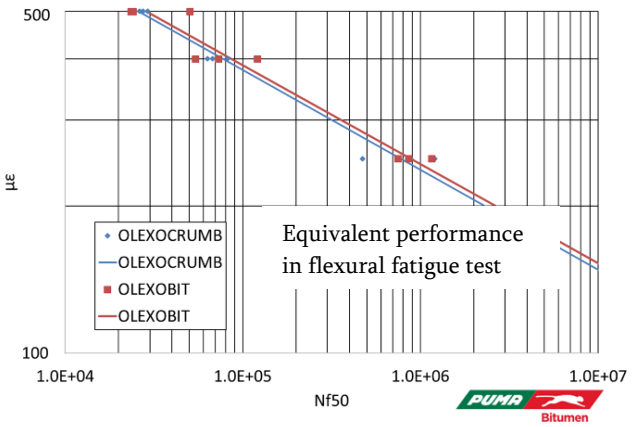
Over the course of months and hundreds of man hours in development time spent on different designs, researchers at Puma Energy had developed the final OLEXOCRUMB® .formulation. The performance of OLEXOCRUMB® equals that of Puma's premium OLEXOBIT® PMB suite of products. OLEXOCRUM®B formulations were developed for Austroads A10E, A15E and A20E grades.

To confirm the performance of OLEXOCRUMB® formulations was tested side by side with the equivalent OLEXOBIT® grades.



Plant Trials

Full scale plant trials at the Puma Bitumen terminal in Altona confirmed that the production method for OLEXOCRUMB® results in negligible crumb rubber residue, meaning it can be used as a direct substitution for conventional bituminous binders. This was achieved thanks to the industry leading, manufacturing equipment at Puma Energy's PMB terminals that are unique to the company.

With the plant trials completed and the properties of the final binder validated, the next stage of the OLEXOCRUMB® development process was full-field implementation.

Field Demonstrations

The field demonstrations of OLEXOCRUMB® were organised in close collaboration with Boral Asphalt, as part of the Boral/Puma technology program.

A large trial of crumb rubber products organised by the Victorian Department of Transport (DoT) was targeted for the launch of OLEXOCRUMB®. As part of a plan to accelerate crumb rubber asphalt implementation, DoT asked the industry put forward designs for high performance asphalt mixes equivalent to their standard 10mm stone mastic asphalt (SMA10) with A20E binder. Successful mix design proposals by the industry would be tested at a trial site on East Boundary Road in Melbourne. Proposals by other companies included gap graded and open graded crumb rubber asphalt mixes, as well as an SMA design with dry blended rubber. The joint submission from Puma and Boral was an SMA10 with OLEXOCRUMB® A20E, complying with the specification requirements for the standard DoT SMA10.

In preparation for the Department's trial, a first demonstration of the SMA10 material with OLEXOCRUMB® A20E was placed on a suburban street in Melbourne in March 2020. The 2400m^2 of SMA10 was laid successfully.

15 tonnes of OLEXOCRUMB® bitumen was used in the trial, giving the equivalent of 225 passenger car tyres a new purpose as durable asphalt surfacing.

Following the achievements of the first trial, the same SMA10 mix with OLEXOCRUMB® A20E was placed as Section 4 of the Victoria DoT crumb rubber trial in late March 2020 on the South Bound lanes of Boundary Street, Bentleigh between Jackson Lane and Kalimna Street.

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The installation was successful and the equivalent of another 225 passenger car tyres were recycled in the form of OLEXOCRUMB® binder in a 30mm thick SMA10 layer on a Victoria DoT road.

Summary

A crumb rubber asphalt binder was developed that can be used in direct substitution of conventional PMB grades. The product contains 10% rubber, and for every tonne, OLEXOCRUMB® repurposes the equivalent of 15 passenger car tyres.

The benefits OLEXOCRUMB® offers over other crumb rubber binder technology currently available in the market, include:

- Can be used in existing asphalt mix designs as a direct substitute for conventional PMB
- Negligible rubber residue, no interference with mix volumetrics, mix stability, or binder content determination
- This is a binder which has been specifically formulated to comply with existing Austroads PMB specifications. It can therefore be used in existing contracts
- The formulation includes warm mix additives allowing the asphalt to be produced at lower temperatures, thus reducing emissions and energy consumption during production and placement.

Availability

OLEXOCRUMB® is available in Austroads A10E, A15E and A20E grades.

The product is currently available in Queensland and Victoria. OLEXOCRUMB® will also launch in New South Wales in late 2020.

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WITH OLEXOCRUMB®

Trusted PMB grades now incorporating 10% recycled tyre rubber

Reducing temperature and emissions in asphalt production and placement

Every tonne of OLEXOCRUMB® binder repurposes the equivalent of 15 locally sourced passenger tyres

Complies with existing Austroads specifications for A10E, A15E and A20E

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