



WARRIP

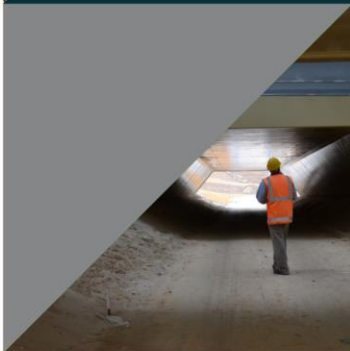
WESTERN AUSTRALIAN ROAD RESEARCH
AND INNOVATION PROGRAM



Review of Future Pavement Technologies

Recycled Plastic Roads

INVESTIGATION OF RECYCLED
PLASTIC USE IN ROAD
PAVEMENT APPLICATIONS



AN INITIATIVE BY:



mainroads
WESTERN AUSTRALIA



RECYCLED PLASTIC IN ROAD PAVEMENTS

During March - December 2016 WARRIP investigated the use of recycled plastic in road applications including asphalt binder and modular pavement. The review included technical benefits and limitations, recent case studies and a review of plastic recycling practices in Western Australia.

Background

Increasing volumes of plastic entering landfill and growing costs of petroleum-based products have made the management of waste plastic a major sustainability issue. Rates of plastic recovery, recycling and reuse are low in WA by national and international standards. The purpose of this investigation was to determine whether this highly valuable resource could be beneficially utilised in road pavement applications.

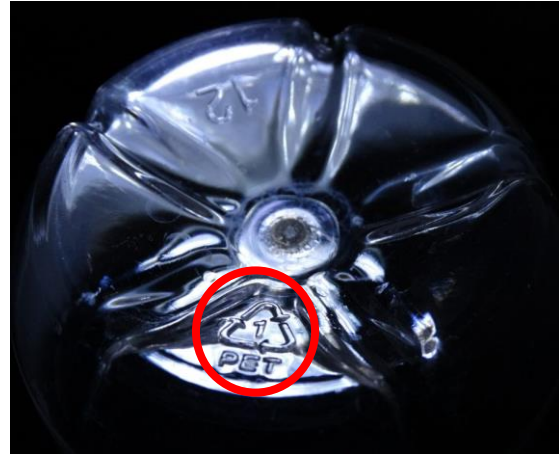
Approach

- Reviewing current national and international practice
- Identifying products that have been developed and/or are in use
- Evaluating identified technologies, particularly regarding likely application in WA
- Conducting an assessment of the relevance of current practices, products and recent research to Main Roads
- Providing recommendations on further investigation of these technologies and what research should be conducted to better inform decisions regarding implementation into practice

Types of Plastics

Common plastics are categorised according to Plastics Identification Code (PIC), distinguished by a number within the sustainability triangle.

PLASTIC BOTTLE SHOWING PIC (CATEGORY 1)



Source: PHS Pallet (n.d.)

Plastics in categories 1, 2 and 3 are generally recycled, whereas the plastics in categories 4-7 are not; often due to the difficulty and expense associated with the recycling process. A summary of plastic types is presented in Table 1.

Table 1: Plastic identification code summary

PLASTIC IDENTIFICATION CODE		
1	PET	Polyethylene terephthalate
2	HDPE	High density polyethylene
3	PVC	Polyvinyl chloride
4	LDPE	Low density polyethylene
5	PP	Polypropylene
6	PS	Polystyrene/expanded polystyrene (EPS)
7	Other	Includes all other resins and multi materials (laminates) such as polyurethane (PU) and acrylonitrile butadiene styrene (ABS)

Recycling Practice in Western Australia

Perryman and Green (2015) found that plastic constitutes only 0.5-0.6% of the total 2.6 million tonne of waste recycled in WA, representing

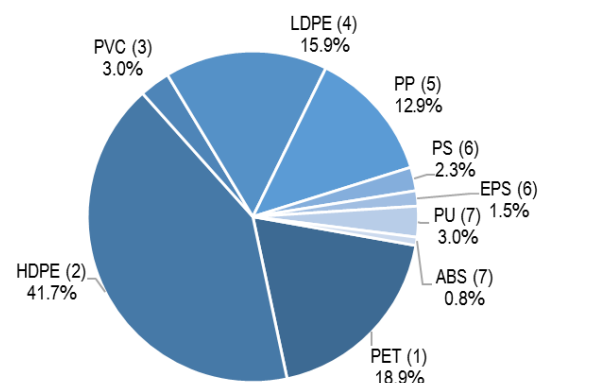
approximately 8% of the 0.2 million tonne consumed annually.

Table 2 Material recycled in Western Australia

YEAR	WASTE RECYCLED (TONNES)	PLASTIC RECYCLED (TONNES)
2013/14	2,605,460	13,200
2014/15	2,622,090	16,400

There are currently five semi-automated waste processing facilities within WA that sort recovered plastic into HDPE, PET and mixed plastic groups. Perryman and Green (2015) provide a summary of recycled plastic by type.

RECYCLED PLASTIC IN WA BY WEIGHT (2013/14)



Source: Perryman and Green (2015)

Barriers to Using Recycled Plastic

- Concerns about the presence of impurities
- Lack of financial incentive for using recycled materials, similar cost compared to virgin
- Lack of local demand in WA, approximately 71-73% exported overseas or interstate
- Indicative HDPE, PET and mixed plastic prices \$1000, \$300 and \$180 per tonne respectively

Recycled Plastic in Asphalt

Numerous studies have investigated the addition of waste plastics to asphalt binders. Generally, the studies found that recycled waste polymers could be utilised to enhance desirable binder/mix properties including stiffness, fatigue and cracking. However, enhanced performance as compared to unmodified binders was considered successful and comparison to equivalent virgin polymers was not pursued. Additionally, the health and safety issues associated with the production and laying of these materials were not addressed. Sources of risk include fumes and odours from waste plastic and associated impurities.

Conclusions and Recommendations

- Recycled plastic can be used as a bituminous modifier for asphalt.
- No identified gaps in plastic waste stream. The majority of recovered waste plastic is on-sold for further processing internationally and to a lesser extent nationally.
- Use of recycled plastic in road pavement applications will compete with established markets.
- Currently not economically feasible, but future government policies, market fluctuations and advanced technologies may create opportunities.

References

Perryman, G & Green, S 2015, *Recycling activity in Western Australia 2013-14*, ASK Waste Management, Perth, WA.

PHS Pallet n.d., *Guide to plastic recycling numbers*, web page, viewed 11 June 2018, <<https://phspallet.com/guide-plastic-recycling-numbers/>>.