ASSESSMENT OF RECYCLED AGGREGATE FOR USE IN THE PAVEMENT SURFACE LAYER

A. Tatari, S.B. Costello and D.J. Wilson

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

Introduction

Skid resistance is the frictional force that is produced between the road surface and the tyres. Over time, the pavement surface is polished by vehicle tyres, reducing the micro-texture of aggregates and macro-texture of the road surface. This results in reduced levels of skid resistance to a point where the surface may need to be replaced or in some way rejuvenated due to poor skid resistance performance.

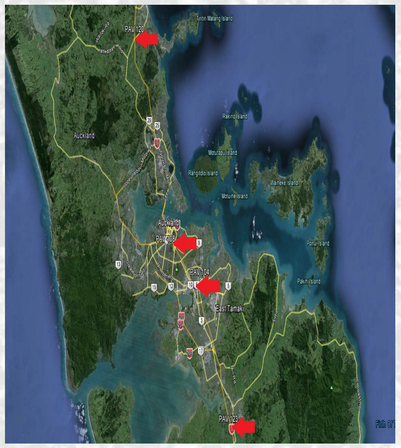
This ongoing research project will assess the possibility of recycling these high value aggregates for re-use in a surfacing layer. In particular, this research focusses on aggregates salvaged from Open Graded Porous Asphalt (OGPA) surfaces used on the Auckland motorway network.

Methodology

➢ **Site Locations**

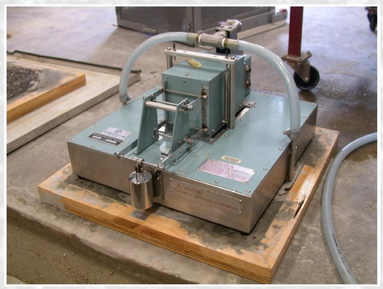
Four sites on the Auckland Motorway network were tested in line with the work instructions to the contractor undertaking the milling and paving works on the motorway network.

- PAV 104, Penrose – SEART , T2 Lane
- PAV 108, Kingsland - Western Springs, Slow Lane
- PAV 120, Silverdale, Slow Lane
- PAV 123, Pahurehure Box Cul-Slippery Crk, Slow Lane



➢ **Measurement of road surface friction:**

Using Dynamic Friction Tester (DFT). ASTM Standard Test Method E-1911



➢ **Measurement of road surface Macro-texture:**

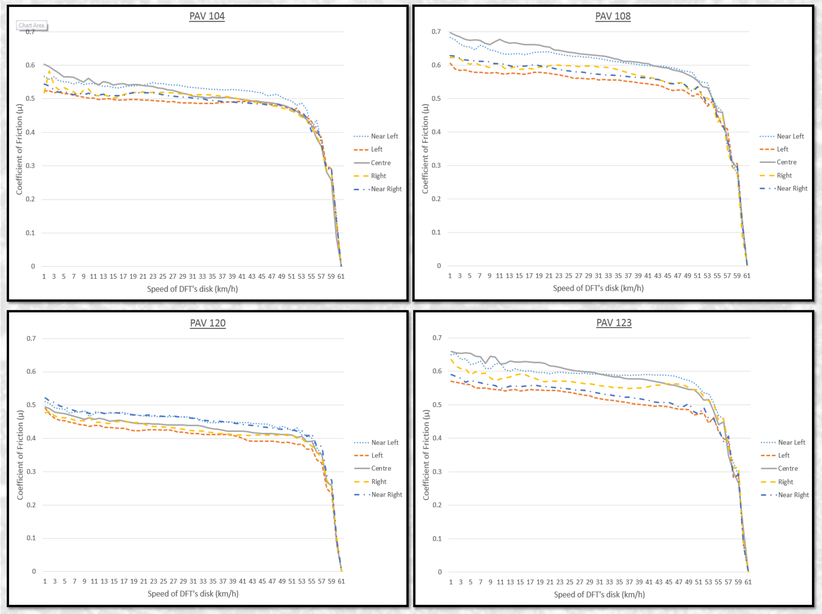
Using Circular Track Meter (CTM) ASTM Standard Test Method E2157

Testing at each site was undertaken at five locations: two of them in the wheel paths, one in the center of the lane and two locations between each wheel path and the road lane markings.

Results

➢ **Dynamic Friction Test Results:**

The in-field results for the DFT at all four sites and in all five locations are shown below. In the graphs, the coefficient of friction (μ) is plotted against the measured slip speed.



Each dataset in the table below presents the average of three test results at each location. The three DFT test results are calculated at 20 km/h, 40 km/h and the average slip speed within this speed range.

Site Name	Average of Coefficient of Friction Results (μ)			
	PAV 104	PAV 108	PAV 120	PAV 123
Centre of Left Wheel Path and Road Lane	0.594	0.732	0.556	0.593
Left Side Wheel Path	0.552	0.634	0.517	0.521
Centre of Wheels path	0.628	0.730	0.514	0.599
Right Side Wheel Path	0.564	0.659	0.507	0.560
Centre of Right Wheel Path and Road Lane	0.560	0.647	0.548	0.534

➢ **Circular Track Meter Results**

The Mean Texture Depth results are shown in the table below. The recorded values are the average of three CTM test results in the same location. These results are for four sites and each site was tested in five locations as explained in the previous section.

Site Name	Mean Profile Depth Results (mm)			
	PAV 104	PAV 108	PAV 120	PAV 123
Centre of Left Wheel Path and Road Lane	1.31	1.45	1.23	1.88
Left Side Wheel Path	1.35	1.45	1.28	1.48
Centre of Wheels path	1.21	1.65	1.41	1.14
Right Side Wheel Path	1.51	1.54	1.06	1.39
Centre of Right Wheel Path and Road Lane	1.85	1.35	1.28	1.13

Discussion

The main findings of the results for coefficient of friction are as follows: According to NZTA T/10 (NZTA, 2010), skid resistance investigation levels (IL) for highway and motorway junction areas including on/off ramps should be between 0.40 μ and 0.45 μ, as measured by the Sideways-force Coefficient Routine Investigation Machine (SCRIM). The minimum and maximum coefficients of friction, across all locations, are 0.507 μ and 0.732 μ, respectively. This would suggest that none of the sites are being resurfaced due to skid resistance failures.

Skid resistance Investigation Level (IL), NZTA T/10 (NZTA, 2010)

Site Category	Skid site description	Investigatory Level (IL), units ESC					
		0.35	0.40	0.45	0.50	0.55	0.60
1	Approaches to: a) Railway level crossings b) Traffic signals c) Pedestrian crossings d) Stop and Give Way controlled intersections (where state highway traffic is required to stop or give way) e) Roundabouts One lane bridges: a) Approaches and bridge deck						
2	a) Urban curves < 250m radius				L	M	H
	b) Rural curves <250m radius			L	L	M	H
	c) Rural curves 250-400m radius		L	L	M	H	
	a) Down gradients > 10%						
	b) On ramps with ramp metering						
3	a) State highway approach to a local road junction						
	b) Down gradients 5-10%						
	c) Motorway junction area including on/off Ramps						
	d) Roundabouts, circular section only						
4	Undivided carriageways (event-free)						
5	Divided carriageways (event-free)						

Minimum Macro-texture requirements (NZTA, 2010)

Permanent speed limit	Minimum macrotexture – Mean Profile Depth (MPD mm)					
	Chipseal		Asphalt concrete, ESC ≥ 0.4		Asphaltic concrete, ESC < 0.4	
	ILM	TLM	ILM	TLM	ILM	TLM
50 km/h and less	1.0	0.7	0.4	0.3	0.5	0.5
Less than or equal to 70 km/h but >50 km/h	1.0	0.7	0.4	0.3	0.7	0.5
Greater than 70 km/h	1.0	0.7	0.9	0.7	0.9	0.7

The main findings of the results for macrotexture are as follows: The NZTA T/10 has two sections for minimum macro-texture requirements; the terms Investigatory Level Macro-texture (ILM) and Threshold Level Macro-texture (TLM) are used to indicate the macro-texture requirement.

As all test results were located on the Auckland Motorway network and the surface layer was asphalt concrete, the minimum macro-texture requirements for speeds more than 70 km/h is set at 0.9 mm for ILM and 0.7 mm for TLM. The minimum and maximum mean profile depth, across all locations, are 1.06 mm and 1.88 mm, respectively. Comparing these results with NZTA T/10 minimum macro-texture requirements, all the areas were in reasonable condition.

Conclusion

None of the sites appeared to have failed the NZTA T/10 requirements for skid resistance or macro-texture. This would suggest that even the surface aggregates still retain high value specification requirements for skid resistance, which further backs up the need to recycle such aggregates for use in the surface layer. The remaining faces of the aggregate have not been polished at all, similarly for aggregates further down in the surface layer of HMAs.

Acknowledgements

I would like to gratefully acknowledge the funding provided by the Ministry of Business, Innovation and Employment (MBIE). I would also like to thank NZ Transport Agency, Auckland Motorway Alliance and Fulton Hogan for their assistance.