

Performance of asphalt mixtures containing recovered crushed glass

Background to study – testing the performance of RCG in asphalt

Demonstration projects using Recovered Crushed Glass (RCG) in asphalt roads in NSW, Victoria, Western Australia and Tasmania have established that RCG mixed with natural sand in asphalt road surfaces performs equally as well as “plain” asphalt. There are now several suppliers in the Australian market who produce and use asphalt which contains RCG.

In 2011, the Packaging Stewardship Forum (PSF) commissioned a study by GHD Geotechnics to undertake modulus testing on asphalt cores, some containing RCG and some without.

The objective was to compare, under laboratory conditions samples of asphalt with and without RCG at a range of temperatures likely to be encountered in the field.

Study scope

The scope included:

- Obtaining test asphalt specimens from asphalt suppliers in Australia some with RCG (2.5% & 5%) and some without.
- Conducting resilient modulus tests over a range of temperatures likely to be encountered in the field.
- Measuring the durability of fine aggregate to confirm the compliance of RCG to relevant state road authorities’ specifications.
- Undertake product degradation testing on RCG samples to compare against samples without RCG.

Key findings

The results of the Resilient Modulus testing clearly show that the fatigue properties of asphalt are independent of the presence of small quantities of RCG as an alternative to natural sand within the range of temperatures most likely to be obtained in the field.

Modulus testing also shows that RCG is a stronger aggregate than natural sand, therefore its inclusion as a percentage in asphalt mix will not impact on the life

expectancy of the pavement. RCG exhibits permeability coefficient similar to that of course sand. Further, its high angularity compared with round sand should improve the stability of the asphalt mixture.

Summary of results

Asphalt suppliers are seeking new sources of manufactured fine aggregate as natural sands become scarce and more costly. A potential source of fine aggregate is RCG.

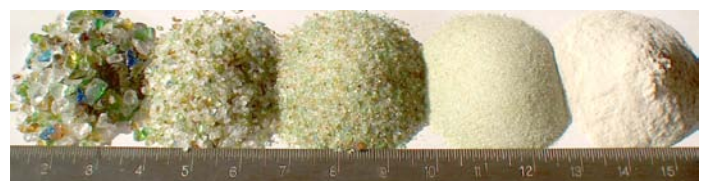
Whilst there is a desire by end-users to promote the use of recycled materials there is often a reluctance to utilise “new” materials without a local field trial. Such trials are costly to conduct with results not being available for a number of years. The other issue with a field trial is that there are so many potential variables that material comparisons may not be measuring like with like.

To assist in the understanding of the likely field performance of asphalt containing RCG fines modulus testing was undertaken in the laboratory over a range of temperatures likely to be encountered in the field. This is different from current practice where all testing is undertaken at a standard temperature (25°C).

Results from modulus and degradation testing undertaken by Sunshine University QLD show there is no significant difference in the laboratory performance of 10 mm asphalt with and without RCG.

When glass is reprocessed properly, it exhibits a permeability coefficient similar to that of coarse sand. Further, its high angularity compared with round sand should improve stability of the asphalt mixture.

Samples of product for testing were provided by Boral Asphalt, Roadways Pty Ltd and Fulton Hogan.



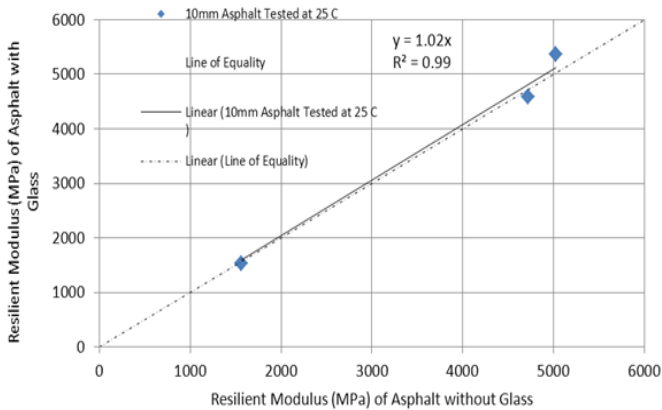
Testing rutting and fatigue

The most common mode of distress for asphalt layers on moderately to heavily trafficked pavements is rutting and fatigue. Rutting is the formation of depression in the wheel paths at high temperatures. It is mixture dependent and is controlled during the asphalt mix design.

Fatigue is the failure of asphalt under repeated loading and under typical pavement temperatures, and is the usual mode of failure under normal traffic conditions.

A simple performance test to predict rutting and fatigue in asphalt is the Resilient Modulus (stiffness) test, which shows how a pavement responds to the applied load. This test was conducted on samples supplied from suppliers in NSW and Tasmania and resilient modulus data was also directly supplied by suppliers in Tasmania and Western Australia.

Resilient modulus Correlations (Tested at 25C)



Asphalt testing machine and environmental chamber

Degradation testing

The degradation factor test measures the durability of fine aggregate caused by self-abrasion in the presence of the water.

State road agencies normally place a minimum limit on degradation factor. For example, VicRoads requires a minimum degradation factor of 60 for crusher fines and manufactured sand to be used as fine aggregates in the asphalt mixture. This test was performed to confirm the compliance of RCG to this durability requirement.

Samples of RCG were tested and both sample provided a degradation factor that exceeded the VicRoads minimum degradation factor.

Source	Location	Vic Roads Specification Requirement	Degradation factor
D	NA	60	97
E	Laverton	60	94



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