



SUSTAINABLE AGGREGATES

SOUTH AUSTRALIA

Properties of recycled crushed concrete for granular basecourse

Engineering Fact Sheet No. 2

Purpose

The purpose of this Fact Sheet is to present information and quantitative data relating to recycled products when used as granular pavement materials, to assist in their fit for purpose selection on a rational and informed basis.

Research program

In collaboration with the University of South Australia's School of Natural and Built Environments, SASA, with the support of ZWSA has embarked upon a technical research program, "The Product Technical Credibility Program", identifying the engineering attributes of recycled pavement material manufacture.

This Fact Sheet supplements the general manufacturing properties of recycled materials associated with the DPTI specifications detailed in Fact Sheet No. 1.

Project characterisation

The research testing program has quantified various parameters associated with intrinsic aggregate properties and static/dynamic load response characteristics of two Class 1 recycled product by comparison to a traditional Class 1 virgin aggregate source, namely:

Intrinsic aggregate properties

- Specific gravity and water absorption AS1141.6.1 and pH AS 1289.4.3.1
- Free lime ASTM C114 – an indicator of potential to 'cement up' in the presence of pozzolanic materials.
- Aggregate abrasion (Los Angeles) AS1141.23 – a measure of aggregate hardness and resistance to abrasion. A maximum value of 30% (Class 1) is associated with granular basecourse and 45% (Class 2) for a subbase.
- Aggregate durability – (micro-Deval) ASTM D6928 – the toughness and durability of aggregate when saturated. A maximum value of 30% loss is associated with granular basecourse.
- Aggregate soundness (sodium sulphate) AS1141.24 – an aggregate's resistance to disintegration by weathering. A maximum value of 12% is associated with basecourse.

Static strength properties

- Maximum dry compressive strength RTA T114 – a measure of aggregate interlock and cementation in granular basecourse. A minimum value of 1.7MPa is associated with granular basecourse.

- Wet strength AS1141.22 – a measure of compressive strength when saturated. A minimum of 70kN is associated with granular basecourse.
- Wet/dry strength variation AS1141.22 – a measure of strength loss under saturation. A maximum of 35% is associated with granular basecourse.
- California Bearing Ratio AS1289.6.1.1 – a measure of bearing capacity ie. resistance to shoving failure in basecourse. A minimum four day soaked value of 80% is associated with granular basecourse.
- Dynamic strength and deformation (repeated loading).
- Resilient Modulus Austroads AG/PT/T053 – a measure of dynamic load response and pavement stiffness, typically a value of 350MPa or 500MPa is associated with mechanistic pavement design. DPTI specification requires a 'characteristic value' to exceed 300MPa (Class 1) and 250MPa (Class 2). In the context of the specification, this requirement overrides the LA abrasion.
- Rate of permanent deformation Austroads AG/PT/T053 – a measure of aggregate breakdown under dynamic loading and used to verify a non conforming LA abrasion value will provide satisfactory basecourse performance. The rate of permanent deformation per load application over 50,000 repetitions is required to be less than 10–8 mm/cycle (Class 1) and 10.

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Results

INTRINSIC AGGREGATE PROPERTIES			
PROPERTY	RECYCLED PRODUCT 1	RECYCLED PRODUCT 2	VIRGIN AGGREGATE
Specific gravity	2.60	2.55	2.58
Water absorption (%)	8.9	5.5	2.3
pH value	8.55	8.73	8.39
Free lime (%)	0.21	0.18	N/A
LA abrasion (%)	39	37	25
micro-Deval (%)	30	28	N/A
Sulphate soundness (%)	19.7	4.05	N/A
STATIC STRENGTH PROPERTIES			
PROPERTY	RECYCLED PRODUCT 1	RECYCLED PRODUCT 2	VIRGIN AGGREGATE
Dry strength (MPa)	2.0	2.4	3.5
Wet strength (MPa)	0.57	0.58	1.20
Wet/dry variation (%)	23	22	27
Soaked CBR (%)	90	120	110
DYNAMIC STRENGTH PROPERTIES (REPEATED LOADING)			
PROPERTY	RECYCLED PRODUCT 1	RECYCLED PRODUCT 2	VIRGIN AGGREGATE
Resilient modulus (MPa)	490 – 690	530 – 1030	480 – 685
Resilient modulus (MPa) @ 80% OMC	675 – 740	655 – 1030	550 – 595
Rate of deformation (µstrain/cycle) @ 80% OMC	(-4.5 to -5) x 10 ⁻⁹	(-4 to -5) x 10 ⁻⁹	-1.5 x 10 ⁻⁸

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