
SECTION 815 - CEMENTITIOUS TREATED CRUSHED ROCK FOR PAVEMENT SUBBASE**815.01 DESCRIPTION**

This section covers the requirements for 20 mm nominal size crushed rock for pavement subbase and treated with cementitious binder to produce a bound material.

Construction of cementitious treated pavement subbase is covered by Section 306.

Supply of cementitious treated crushed concrete for pavement subbase is covered by Section 821.

815.02 DEFINITIONS**Assigned Los Angeles Value**

The assigned Los Angeles Value is a hardness rating derived from Los Angeles Value test results assigned to each source by VicRoads on an annual basis as a part of the accreditation process, on the basis of test data obtained from testing products.

Cementitious Binder

A cementitious material capable of being uniformly mixed into a granular pavement material to bind the particles together to increase its strength. Cementitious binders include Portland cement Type GP or blended cement Type GB, or a blend of ground granulated blast furnace slag (GGBFS), hydrated lime, fly ash, alkali activated slag or other pozzolanic material supplied in accordance with this specification.

Cement Treated Crushed Rock

Cement treated crushed rock is a mixture of crushed rock fragments, cement and water or crushed rock with approved additives, cement and water produced at a controlled mixing plant to close tolerances of grading, moisture content and binder content.

Fine Aggregates

The portion of the crushed rock mixture passing the 4.75 mm sieve

Fly Ash

A fine powder of pozzolanic material extracted from the flue emissions produced from the burning of black coal complying with the requirements of the current Australian Standard for Supplementary cementitious materials for use with General purpose and blended cement – fly ash as listed in Section 175.

Pozzolan

A siliceous or alumino-siliceous material when finely ground can be mixed with lime or Portland cement to form a cementitious material.

Slag (Ground Granulated Iron Blast Furnace Slag)

Ground Granulated Iron Blast Furnace Slag (GGBFS) complying with the requirements of the current Australian Standard for Supplementary cementitious materials for use with General purpose and blended cement - GGBFS as listed in Section 175 is a pozzolan produced by fine grinding of slag produced as a by product from the smelting of iron ore.

Additive

A material that may be added to a crushed rock to improve its workability and physical properties.

815.03 SOURCE ROCK

Source rock shall comply with the requirements specified in Section 801 - Source Rock for the Production of Crushed Rock and Aggregates and be obtained from an accredited VicRoads source.

815.04 COMPONENTS**(a) Coarse Aggregates**

Coarse aggregates shall consist of clean, hard, durable, angular rock fragments of uniform quality from a source complying with the durability and soundness requirements specified in Clause 815.03 and Table 815.051.

(b) Fine Aggregates

Fine aggregates shall consist of clean, hard, durable, angular rock fragments of uniform quality.

If all or part of the fine aggregates (igneous and metamorphic rock sources only) are produced from a different bench or location within the source to that of the coarse aggregates, such that on any day are not represented by the Unsound and Marginal Rock Content tests undertaken on the coarse aggregates or are separately added into the manufacturing process, the combined fraction of fine aggregates shall be tested for Degradation Factor – Fine Aggregate at the frequency specified in Table 815.141. The Degradation Factor – Fine Aggregate of a sample of the combined fine aggregates prior to mixing in of any additives, shall not be less than 60.

If all or part of the fine aggregates (igneous and metamorphic rock sources only) is to be imported from a different source or manufactured from a different rock type to that of the coarse aggregates, the Contractor shall obtain approval of the Superintendent prior to use. The Contractor shall provide details of the exact location of the source and nature of the fine aggregates and the proposed percentage by mass to be added to the crushed rock mixture.

If approved for use, all imported fine aggregates produced from igneous and metamorphic rock sources shall have a Degradation Factor – Fine Aggregate of not less than 60.

(c) Additives

Additives which are non durable or subject to appreciable breakdown will not be permitted. The addition of crushed brick or Reclaimed Asphalt Pavement (RAP) is not permitted in cement treated crushed rock.

VicRoads will only approve the addition of an additive as a part of a registered crushed rock mix design submitted in accordance with VicRoads Code of Practice for Registration of Crushed Rock Mix Designs as listed in Section 175.

Where clayey sand additives are incorporated into the crushed rock, the total amount of any additive shall not exceed 15% of total dry mass of the crushed rock product. If clayey filler is used as all or part of the total additive, the total amount of clayey filler additive shall not exceed 2% of the total dry mass of the crushed rock product.

The use of additives shall comply with all relevant requirements of Clause 812.04(c).

(d) Blending of Coarse Aggregates

Coarse aggregates imported from different sources or rock types shall not be combined with crushed rock aggregates without prior approval from the Superintendent.

Any proposal to blend aggregates from different sources or rock types shall clearly state the proportions by mass retained on each sieve for each rock type that will be used in the blend. Blending of products containing coarse aggregates shall comply with all requirements of Clause 812.04(d).

815.05 PRODUCT

Cement treated crushed rock mixes for use on specified works can be registered in accordance with VicRoads Code of Practice for Registration of Crushed Rock Mix Designs as listed in Section 175.

- (a) The cement treated crushed rock shall be free from vegetable matter and lumps or balls of clay and shall comply with the relevant requirements of Table 815.051.

Table 815.051 Unsound and Marginal Rock Content

Total of Marginal and Unsound Rock % (max)	Unsound Rock % (max)
20	10

- (b) The mixture before the addition of cementitious binder shall comply with the requirements of Table 815.052.

Table 815.052 Test Properties

Test	Test Value
Liquid Limit % (max)	35
Plasticity Index (max)	10

815.06 CEMENTITIOUS BINDER**(a) Cement**

Portland and blended cements shall be Type GP (rapid setting binder) or GB (medium setting binder) and comply with the requirements of the current Australian Standard for General purpose and blended cements as listed in Section 175. It shall be stored in weatherproof structures, and any cement damaged by moisture shall not be used.

If Type GB cement is proposed, only the following blends are permitted:

- (i) Cement/Slag blend (50% to 60% cement content)
- (ii) Cement/Fly Ash blend (70% to 80% cement content)
- (iii) Cement/Slag/Fly Ash blend (55% to 65% cement content).

(b) Slag/Lime Blends

Slag and hydrated lime may be used in blended combination as a slow setting cementitious binder. The requirements for hydrated lime shall be as specified in the current Australian Standard for Limes and limestones as listed in Section 175. Slag used shall be Ground Granulated Iron Blast Furnace Slag (GGBFS) meeting the requirements of the current Australian Standard for Supplementary cementitious materials for use with General purpose and blended cements - GGBFS as listed in Section 175. The Contractor shall nominate the type, brand and source of the GGBFS to be used.

Slag/lime shall be blended uniformly in the ratio of 85% slag to 15% hydrated lime unless laboratory testing indicates that superior strength of the cement treated crushed rock is achieved by using a different ratio. If the blend is to be varied, the proportion of lime shall not be less than 10%. The Contractor shall provide evidence that the blend ratio has been met for all material supplied to the job. Slag/lime blend shall have a mortar bar 7 day compressive strength of 10 MPa and 28 day mortar bar compressive strength of 16 MPa. The test shall be the same test specified for Portland and blended cement except that the cement to water ratio shall be adjusted to match the consistency of mortar produced for the compressive strength test for GB cement in accordance with the relevant Australian Standard Test Method.

(c) Slow Cementitious Blends Incorporating Alkali-activated Slag or Fly Ash

Special blends of slow setting cementitious stabilising agents incorporating alkali-activated slag or fly ash which do not meet mortar bar strength requirement specified for Portland and blended cement may be used subject to the blend satisfying the mortar bar test requirement specified in Clause 815.06(b). The maximum binder working time shall be determined in accordance with the VicRoads Test Method for Portland and blended cements as listed in Section 175.

Fly ash shall be supplied to meet the requirements of the current Australian Standard for Supplementary cementitious materials for use with General purpose and blended cements – fly ash as listed in Section 175.

815.07 ADDITION OF WATER

Water added to the crushed rock shall be clean and substantially free from detrimental impurities such as oils, salts, acids, alkalis and vegetable substances. Water sources shall be tested prior to use for electrical conductivity and pH, in accordance with the current Australian Standards as listed in Section 175. The electrical conductivity shall not be more than 3500 $\mu\text{S}/\text{cm}$ and pH within the range of 6 to 10. Water sources classified by the relevant Water Authority as potable water shall be exempt from this requirement. Water sources shall be tested at a maximum of twelve monthly intervals or when in the opinion of the Superintendent the nature of the water source has changed. The use of reclaimed water will require the approval of the Superintendent and shall conform to VicRoads guidelines for recycled water for road activities as listed under other referenced documents in Section 175.

815.08 MIXING

The crushed rock, additive (if any), cementitious binder and water shall be mixed by continuous pugmill or batch mixing.

The mixing period and the time of addition of water shall be such as to produce a uniform mixture of the components.

815.09 GRADING OF CRUSHED ROCK WITHOUT CEMENTITIOUS BINDER

The crushed rock, just prior to the addition of cementitious binder, shall comply with the relevant grading requirements in Tables 812.081 or 812.082 in Section 812 corresponding to the assigned Los Angeles Value (LAV) of the source rock and the nominal size of the material.

The mixture shall not be graded from near the coarse limit in one sieve to the fine limit on the following sieve or vice versa.

Initially the target grading shall be at the centre of the grading envelope but the Contractor may vary the target grading within the specified grading limits to optimise the cementitious binder content required to satisfy the Unconfined Compressive Strength (UCS) requirements specified in Table 815.101. Regardless of the target grading selected, the production grading shall not extend outside the specified grading limits.

815.10 CEMENTITIOUS BINDER CONTENT AND UNCONFINED COMPRESSIVE STRENGTH (UCS) REQUIREMENTS**(a) Cementitious Binder Content**

The Contractor shall determine the content of cementitious binder required to meet the minimum 7 day UCS specified in Table 815.101 using modified compaction. The cementitious binder content may be further increased to allow for the effects of production variability. The binder content so determined shall become the Design Cementitious Binder Content which shall not be less than the minimum cementitious binder content specified in Table 815.101. During manufacture, the cementitious binder content shall be determined in accordance with the current Australian Standard for Cement content of cement stabilized materials as listed in Section 175.

Cementitious binder shall be added and mixed into the crushed rock to produce a uniform binder content.

After mixing, the cementitious binder content of the mixture, expressed as a percentage by mass of the dry crushed rock, shall be within $\pm 0.3\%$ of the Design Cementitious Binder Content.

(b) Unconfined Compressive Strength Test

The Contractor shall carry out UCS testing in accordance with the test frequency specified in Table 815.141. The UCS test result shall be the mean UCS determined from a pair of specimens in accordance with the current Australian Standard for unconfined compressive strength of compacted materials as listed in Section 175 and compacted using modified compactive effort.

For the purposes of UCS testing, one representative sample of fully mixed cement treated material shall be taken either from the plant or at the point of delivery in accordance with the current Australian Standard for Unconfined compressive strength of compacted materials as listed in Section 175 and compacted in the mould within two hours of mixing.

The UCS during production shall be assessed on a 'rolling average' basis where the average of the most recent three UCS test results shall not be less than the minimum value specified in Table 815.101.

Table 815.101 Cementitious Binder Content and Unconfined Compressive Strength

Pavement Design Modulus (MPa)	Minimum Design Cementitious Binder Content (% by mass)	Minimum 7 day Mean UCS (MPa)		
		Rapid Setting (GP Cement)	Medium Setting (GB Cement)	Slow Setting (Supplementary Cementitious Blends)
≤ 500	3	4	#	#
> 500 or ≤ 3500	3	5	3.5	3

815.11 MOISTURE CONTENT

Where the contract includes supply and delivery only, the moisture content of the mixture at the point of delivery, expressed as a percentage by mass, shall be within plus 0.5% to minus 1.0% of the target nominated by the Superintendent.

815.12 STOCKPILING OF MIXTURE

Where cement treated crushed rock is temporarily stockpiled, prior to loading, the batching time shall be recorded on the delivery docket.

815.13 HANDLING OF MIXTURE

Handling of the mixture, including discharging from mixing plant and loading of trucks, shall minimise segregation.

815.14 MINIMUM TESTING REQUIREMENTS

The Contractor shall test the cement treated crushed rock at such a frequency to ensure that all material consistently complies with the specified requirements.

The test frequency shall initially not be less than that shown in Table 815.141, except that the test frequency for Grading, Unsound Rock Content, Plasticity Index, UCS and Degradation Factor – Fine Aggregate may be halved, where the ten most recent test results in succession have met specification requirements. If any subsequent test result fails to meet specification requirements, another test shall be immediately undertaken. If the second test fails, the test frequency shall revert to the minimum frequency specified in Table 815.141 and the Contractor shall not return to half the test frequency until a further 10 successive test results comply with specification requirements.

Table 815.141 Minimum Frequency of Testing

Test	Minimum Frequency of Testing
Grading	On each production day: One per 500 tonnes or part thereof except where total production on any day less than 100 tonnes.
Unsound Rock Content	One per production day of a sample taken from the crushed rock product prior to addition of cementitious binder.
Cementitious Binder Content	On each production day: One per 500 tonnes or part thereof except where total production on any day is less than 100 tonnes.
Moisture Content	On each production day: One per 500 tonnes or part thereof except when total production on any day is less than 100 tonnes.
Plasticity Index	In each month: One per 5000 tonnes or part thereof.
Degradation Factor - Fine Aggregate *	One per production day for crusher fines imported from another source or location within the source to that of the course aggregates.
Mean Unconfined Compressive Strength	In each week: One per 2000 tonnes or part thereof. If production in any week is less than 500 tonnes, the quantity may be added to the total production in the following week(s) until a total of 500 tonnes is reached.

* Applies only to igneous and metamorphic rock sources.