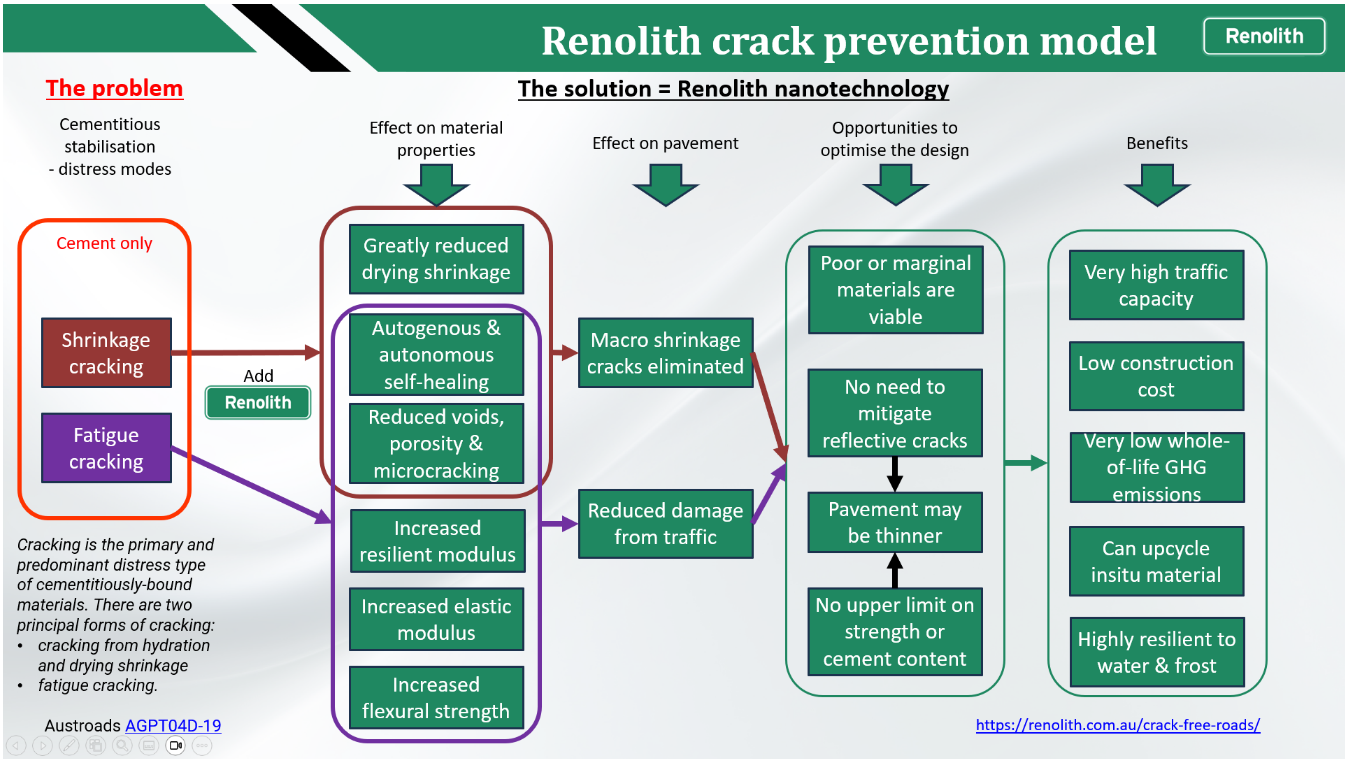
Title

Renolith 2.0 Product Sample Kit Instructions

Context

Renolith 2.0 is a nanopolymer admixture conforming to standard *EN 934-2: Admixtures for concrete, mortar and grout*. In chemical terms, it is a colloidal suspension comprising a latex emulsion and stable colloidal dispersion of nanosilica and nanocellulose. It is compatible with ordinary Portland cement and with binder blends containing supplementary cementitious materials (SCMs). It is most often used for creating high performance bound base layers in flexible pavement applications using conventional insitu or plant-mix cementitious stabilisation methods. Its most important function is to prevent macro-cracking of cemented materials, thus alleviating a critical constraint in pavement design.



A substantial body of evidence characterizes the efficacy of Renolith in pavement and concrete nanoengineering applications. However, there are myriad variables and potential applications. Accordingly, samples are provided to allow interested parties to test the utility of the product.

Aim

The purpose of this document is to convey key information for the safe and effective use of the Renolith 2.0 product sample (see https://renolith.com.au/sample/).

Safety information

Renolith 2.0 is non-hazardous. Prior to handling, please review the Renolith 2.0 Safety Data Sheet available at https://renolith.com.au/resources/

Laboratory tests

For pavement applications, The AustStab Pavement Recycling and Stabilisation Guide [1], NZ Transport Agency Best practice guide for pavement stabilisation [2] and AustRoads Guide to Pavement Technology Part 4D: Stabilised Materials [3] provide guidance on mix design and laboratory testing. The table below indicates the expected laboratory test results (per AustStab Guide Ch4) that will result from adding Renolith 2.0 admixture to the mix compared to binder-only mixes.

Test	Expected test result / notes (cf cement-only)
4.2.2. Unconfined Compressive Strength (UCS) Test	20%-80% increase
4.2.3. Triaxial Compression test	20%-80% increase
4.2.4. Permeability test	Decrease by 1-2 orders of magnitude
4.3.1. Particle size distribution (grading)	No impact. Note: poorly graded soils may become viable.
4.3.2. Atterberg tests (liquid limit and plastic limit)	Slight reduction in plasticity. Note: AustStab Guide [1] states that a plasticity index (PI) range of 2-6 is typically specified for base material. A much broader range can be viable with Renolith-enhanced bound material.
4.3.3. California Bearing Ratio (CBR) and percentage swell	Soaked & unsoaked CBR: increase – results vary by soil and binder type. Swell %: Reduced
4.4. Maximum Dry Density (MDD) and Optimum Moisture Content (OMC)	Suggested water content in mix design is slightly on the wet side of OMC at 98% MDD.
4.5. Particle size distribution (PSD) plasticity, reactivity	Standard PSD, plasticity and reactivity envelopes can be expanded.
4.6. Compaction	The required compactive effort is slightly reduced.
4.7. Capillary rise	Reduced – results will vary by soil and binder type.
4.8. Vertical saturation	Improved performance
4.9. Lime demand	No impact
4.10. Resilient modulus (M_r)	Significant improvement. Recycled Concrete Aggregate (RCA) example: • RCA only: M_r =120MPa • RCA+2%Cement: M_r =262MPa • RCA+4%Cement: M_r =341MPa • RCA+2%Cement+Renolith: M_r =345MPa • RCA+4%Cement+Renolith: M_r =399MPa M_r increases with higher cement content. Renolith at optimum dose improves it further.
4.11. Fatigue characterisation	Significant improvement Orders of magnitude improvement in fatigue life can be achieved via modest improvements in flexural strength, elastic modulus and resilient modulus.
4.12. Working time	Typically similar at low or standard dosage (5%). The product improves workability (increased working time) but accelerates curing (reduced

Test	Expected test result / notes (cf cement-only)
	working time). At higher dosage, working time tends to increase.
4.13. Erodability	Reduced. Erodability can also be reduced by adding more binder, but drying shrinkage problems often limit the maximum binder content. With Renolith, drying shrinkage is not a concern, so binder content can be increased if required.
4.14. Leaching	Reduced. Contaminant immobilisation via micro-encapsulation is often viable due to the reduced porosity & permeability of the bound material.
Permanent deformation: $\varepsilon_{p-5000} - \varepsilon_{p-3000}$	Significant improvement vs unbound, marginal improvement vs cement only. Recycled Concrete Aggregate (RCA) example: • RCA only: 0.0115% • RCA+2%Cement: 0.0044% • RCA+2%Cement+Renolith: 0.0041%

AustStab Pavement Recycling and Stabilisation Guide [1] table 3.3 and Austroads AGPT04D-19 [3] table 8.1 list appropriate laboratory test methods for stabilised materials.

Tips

- **Tests focus.** Compared to cement-only mixes, Renolith 2.0 admixture effects on shrinkage, porosity, permeability, tensile strength, resilient modulus, permanent deformation and fatigue performance are remarkable. Consider testing for these parameters. Drying shrinkage is arguably the most important parameter because without Renolith, crack size increases with higher cement dosage.
- **Binder.** Renolith 2.0 admixture is compatible with Cement, Lime and Cementitious binders per Austroads AGPT04L-09 [4]. Historically, most projects have used ordinary portland cement (OPC). Consider using medium or slow-setting cementitious binders for improved performance, increased working time and reduced environmental impact.
- **Mix design**
  - For stabilisation applications, refer to AustRoads and AustStab guidance. See also Renolith Pavement Design Guide.
  - For most applications, optimal dosing of Renolith 2.0 admixture is 5% w/w binder. In poor soils (silts, clays), 8% dosage may yield better results.
  - Renolith 2.0 admixture is suitable for Modified, Lightly Bound and Bound stabilisation mixes. The greatest utility is in Bound (UCS >2MPa) and Heavily-bound (UCS > 3 MPa) designs. Due to the much reduced susceptibility to shrinkage cracking, conventional upper bounds on binder content may be exceeded. See https://renolith.com.au/crack-free-roads/
  - Example mix designs for testing:

Application	Lightly-bound	Heavily-bound	Concrete
Material mass	10kg	10kg	10kg
Nominal cementitious binder content	2% (200g)	4% (400g)	10%-15% (1000g-1500g)

Application	Lightly-bound	Heavily-bound	Concrete
Renolith 2.0 admixture @5% w/w binder	10g	20g	50-75g
Water	~OMC	~OMC	per manufacturer recommendation

- **Storage and shelf life.** Store sample in a cool place out of direct sunlight. Shake well before use. If the sample is discoloured (should be white) or emits a strong odour it might have expired - seek a fresh sample.

Standards

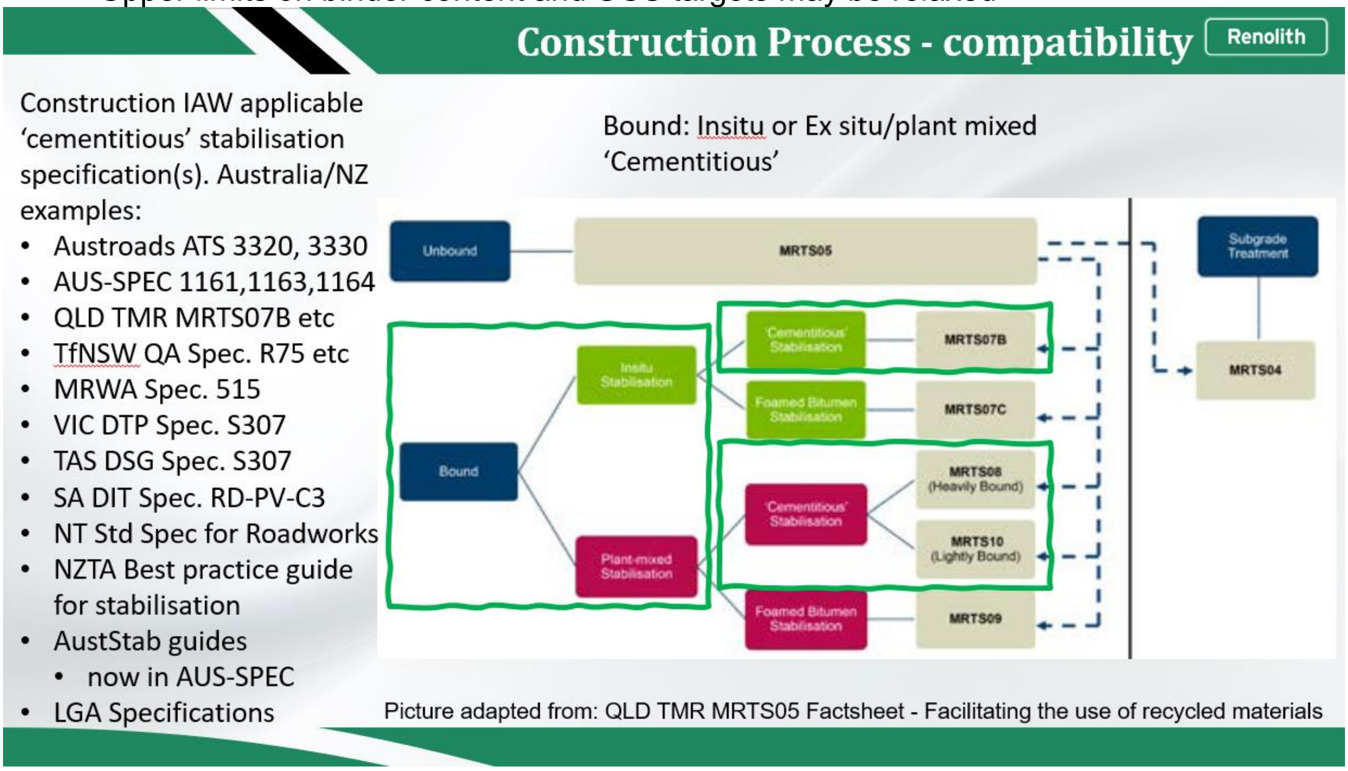
Due to the numerous beneficial effects and potential applications of the product, no single standard or test method is applicable. Certain standards from the following series may useful:

AS 1012	Methods of testing concrete
AS 1141	Methods for sampling and testing aggregates
AS 1289	Methods of testing soils for engineering purposes
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 3582	Supplementary cementitious materials
AS 5101	Methods for preparation and testing of stabilized materials

Specifications

It is recommended that Renolith 2.0 be used in conjunction with the 'best practice' cementitious stabilisation specification relevant to the project/jurisdiction; examples below. Some tailoring of the specification may be appropriate to optimise the mix design and take advantage of the product benefits. For example:

- Grading and plasticity index requirements may be relaxed
- Upper limits on binder content and UCS targets may be relaxed



General information

- Homepage: https://renolith.com.au/
- About page: https://renolith.com.au/about/
- Product page: https://renolith.com.au/product/
  - Includes introduction videos
- Resources page: https://renolith.com.au/resources/
  - Includes PDS, SDS, case studies, testimonials, videos
  - Introductory videos
    - 20min version: Renolith Nanotechnology - A Brief Introduction
    - 40min version: Road Pavement Nanoengineering 101 for Australian Local Government
  - Business Case
    - Summarises the case studies and research to support the benefits & cost savings claimed.
  - Pavement Design Guide
    - Provides guidance on mix design, pavement thickness and construction process.
    - Supports pavement evaluation and design.
- Articles and case studies are available via: https://renolith.com.au/news-media/
- Research Summary (available on request)
  - Summarises the evidence (research, tests, case studies, patents, investigations) that characterises the product and supports the performance claims.

References

[1] AustStab, Pavement Recycling and Stabilisation Guide, Cherrbrook NSW: AustStab, 2015 2nd Ed.

[2] W. Gray, "Best practice guide for pavement stabilisation," NZ Transport Agency, Wellington, 2017.

[3] Austroads AGPT04D-19, "AGPT04D-19, Guide to Pavement Technology Part 4D: Stabilised Materials," Austroads, Sydney, 2019.

[4] AustRoads AGPT4L-09, "AGPT4L-09 Guide to Pavement Technology Part 4L - Stabilising Binders Ed1.1," AustRoads, Sydney, 2018.

Change History

Date	Version	Notes / changes
03 Jul 23	1.0	Initial release
07 Aug 25	1.1	Minor updates. Additional links.
01 May 26	1.2	Added resilient modulus & permanent deformation data
07 May 26	1.3	Updated crack prevention model graphic