Hi-Lab Guidance Notes – September 2022

Waka Kotahi released a Draft Specification for Hi-Lab back in 2020. Up to this point, there have been various iterations of the Hi-Lab specifications for various projects where many of the parameters have been changed to enhance performance, constructability and manufacturability.

The notes below are meant to provide guidance ONLY to Quarry operators wishing to produce Hi-Lab and in no way meant to replace any Waka Kotahi specification or specific project requirements.

From the draft specification

"This specification describes aggregate materials and construction methodology for a new pavement construction technique, referred to as High strength Low fines Aggregate Base (Hi-Lab). Hi-Lab pavements have a very specific aggregate particle size distribution consisting of good quality crushed angular stone combined with low cement and fines content which - allows the layer to act as a solid mass - thereby enabling direct load transfer between larger stone particles"

"Cement modified layer consisting of good quality crushed stone with a specified particle size distribution of nominal maximum stone size of 63 mm. It is intended to be used as a base and/or subbase layer in a flexible or semi-rigid pavement application."

"Cement modified layer consisting of good quality crushed stone with a specified particle size distribution of nominal maximum stone size of 37.5 mm. It is intended to be used as basecourse in a flexible pavement or semi-rigid application."

The draft details both Hi-Lab 65 and Hi-Lab 40 specifications, although several recent projects have opted for Hi-Lab 65 only.

There are several factors that Quarry operators need to keep front of mind while developing their manufacturing methodologies for Hi-Lab.

Specification

Given that the specification is still in draft only, you should assume that further changes could be made from project to project and that you will need to confirm requirements at tender stage. AQA was informed that a revised specification will be published near the end of 2022 but it is unlikely to affect aggregate suppliers.

Grading

Quarry operators need to be aware that Hi-Lab grading limits are specified for the quarry operator, while the contractor installing the Hi-Lab needs to meet a slightly different grading



specification sampled "Behind the Hoe". Any supplier of Hi-Lab will need to consider the requirement to vary the gradings at production or final mix design to ensure the contractor installing the Hi-Lab can meet grading requirements. It is recommended that a blending operation with three constituents be used.

The wet sieve grading limits themselves are narrow and coarsely graded. Buffer limits are also detailed. The idea being that individual results are allowed to wander into the buffer, but the rolling average of 5 tests must lie within normal limits.

Generally most manufactures will need to consider the <20mm all in by-product yielded during Hi-Lab production. Volumes can be considerable.

Sieve Size	Hi-Lab 40	Hi-Lab 40	Hi-Lab 65	Hi-Lab 65
(mm)	Ex-Quarry	Post-Hoe	Ex-Quarry	Post-Hoe
75				100
63			95 - 100	95 - 100
53		100		
37.5	90 - 100	90 - 100	(35) 40 - 50	45 - 55
19.0	(20) 25 - 35	30 - 40	(15) 20 - 30	20 - 30
9.5	(13) 15 - 20	15 - 22	(10) 12 - 16	12 - 16
4.75	(9) 10 - 15	10 - 15	(9) 10 - 14	10 - 14
2.36	(6) 7 - 12	7 - 12	(6) 7 - 12	8 - 12
1.18	(3) 4 - 10	5 - 10	(4) 5 - 10	6 - 10
0.075	0 - 6	0 - 6	0 - 6	0 - 6

The following table shows the particle size distribution required for Hi-Lab 40 and 65.

The following graph shows the Hi-Lab 40 particle size distribution limits.







The following graph shows the Hi-Lab 65 particle size distribution limits.

Choking Aggregate

PAP 7 shall be a by-product of Hi-Lab production and will be used as a choking aggregate. After each layer of Hi-Lab is stabilised, it is choked off with a thin layer of PAP 7.

Quality of Fines (QoF) / Cleanness of Particles

QoF criteria are similar to typical NZTA M/4 requirements, although the ratio to fines and coarse material is quite different to M/4 and as such, you may not always achieve similar QoF levels. Recent projects have also reported that the coarse aggregate components of the mix need to be clean to ensure the final product works well with the cement binder.

If the Sand Equivalent is <40, then <u>both</u> Clay Index \leq 3 and Plasticity Index \leq 9 must be met.

Shape of Particles

As the strength of this type of pavement relies heavily on the particle to particle contact, particle shape is key. The quarry operator will need to trial different crushing methodologies to achieve the required shape characteristics. Noting that **EACH SIZE FRACTION** is expected to achieve the **less than 30%** shape requirements.

Strength and Durability of Rock

Again, due to the pavement design, particle to particle contact means the rock used to make Hi-Lab must be of good sound quality. The quarry operator will need to demonstrate that the final product will comply with the new Ethylene Glycol Accelerated Weathering test.



For many of the criteria, the coarse grade Hi-Lab product will not always yield the required sized fractions needed for some of the tests. Quality plans will need to address how and where samples are taken to sufficiently represent the final product's characteristics.

Aggregate Source Rock Quality
Requirements Test PropertyTest MethodRequirementsCrushing ResistanceNZS 4407 Test 3.10< 10% Fines @ 160kN</td>Weathering Quality IndexNZS 4407 Test 3.11AA, AB, AC, BA, BB or CAAccelerated Weathering IndexNZTA T20Proportional change < 30%</td>Solid Density TestingNZS 4407 Test 3.7.1

Source property testing is required for every 20,000 tonnes of source material, with solid density testing requiring two results before construction as well as ongoing testing.

Performance

The Quarry source will need to demonstrate that Repeated Load Triaxial testing carried out on NZTA M/4 AP40 from the same representative source rock and crushing methodology will comply. Samples shall be compacted to 81 - 83 % of solid density at a moisture content between 4.0 % and 6.0 %.

Under the dry/drained test condition the average permanent strain slope for all 6 stages shall be less than 0.55 % at a total of 300,000 load cycles.

Sampling and Segregation

Given the nature of the grading, the Hi-Lab products are more susceptible to segregation in stockpile and during load out. Care must be taken to avoid this. Aggregate is required to be loaded into the spreader trucks directly from the quarry and in a *"wetter than optimum state"*.

Thought should be given to sampling techniques with many opting for belt sampling in the quarry blending plant or larger samples than the 90kg specified for each test.

The sampling rate for production testing is 1 test per 1000t or a minimum of 5 samples per stockpile, whichever gives the greater number of samples.

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