January 25th, 2021

Lithified Technologies US LLC
218 Camino La Tierra
Santa Fe, NM 87506

Attention: Mr. Roy Mullin

Regarding: Lithified Technologies Additive Blend MI-020-00001

Dear Mr. Mullin:

I have completed a supplemental laboratory analysis of the chemically treated soil composition provided to Lithified Technologies utilizing the additive blend provided by Lithified Technologies labeled Composite Bulk Sample MI-020-00001. The following memorandum is a summary of our results.

MATERIAL COMPOSITION

The material composition that was tested consisted of 54 percent crushed limestone (GP), 38 percent pulverized Hot Mix Asphalt (HMA) and 8 percent sandy lean clay with silt (CL). Based on my experience this is generally representative of an idealized gradation for Full Depth Reclamation using Portland cement as a stabilization additive. This is the result of the ratio of fine particles provided by lean clay to the void ratio of compacted crushed aggregates and reclaimed HMA. Additionally, this is true only with lean clay soils with low plasticity indices as fat clays (CH) are potential expansive and have a greater potential to draw in and hold water via capillary action.

LABORATORY TESTS PERFORMED

As the samples provided were representative of a project and mix design under construction in our region, the samples had already been assessed for their moisture density (proctor) relationships as well as particle size distribution, liquid limit/plastic limit (Atterberg) as well as their internal stress/strain relationship and unconfined compressive strength with conventional Portland cement as an additive. These results were compared to Lithified Technologies test results provided on Friday July 24th, 2020 and appear to generally correspond within acceptable margins of error.

Three sets of samples were prepared in accordance with ASTM D1633 at 3, 5 and 7 percent of additive blend MI-020-00001 by mass. The samples were then subjected to repeated saturated freeze/thaw cycling in accordance with ASTM D560 with modifications as follows. One of the three samples from each application rate were fully submerged for 12 hours prior to freezing for 12 hours and thawing while fully submerged for 12 hours before freezing again. Prior to refreezing, the samples were subject to abrasion (scratched) and reweighed in order to calculate mass loss. While this method has been withdrawn or discouraged by the industry due to inconsistencies in abrasive effort, it is still regarded as a standard method per United States Army Corps of Engineers (USACE) and the FAA in certain applications. Mass loss is a better indicator of freeze/thaw durability as that mode of failure typically behaves as a "Hinge" mechanism when plotted as a curve with the final point of failure occurring over 2 or 3 cycles. As such it is more relevant than just initial and residual strength because it indicates a point of failure if the sample fails at all. Additionally, the full submergence and long-term saturation is a more aggressive approach to deteriorating the samples then capillary soak methods and as a result provides a more conservative analysis.

An additional sample from each application rate was tested prior to starting the freeze thaw testing for its unconfined compressive strength per ASTM D1633.

The third sample from each application rate was subjected to the same saturated freeze/thaw regiment as the mass loss sample however it was not subject to abrasion. The sample was then tested for its residual unconfined compressive strength per ASTM D1633.

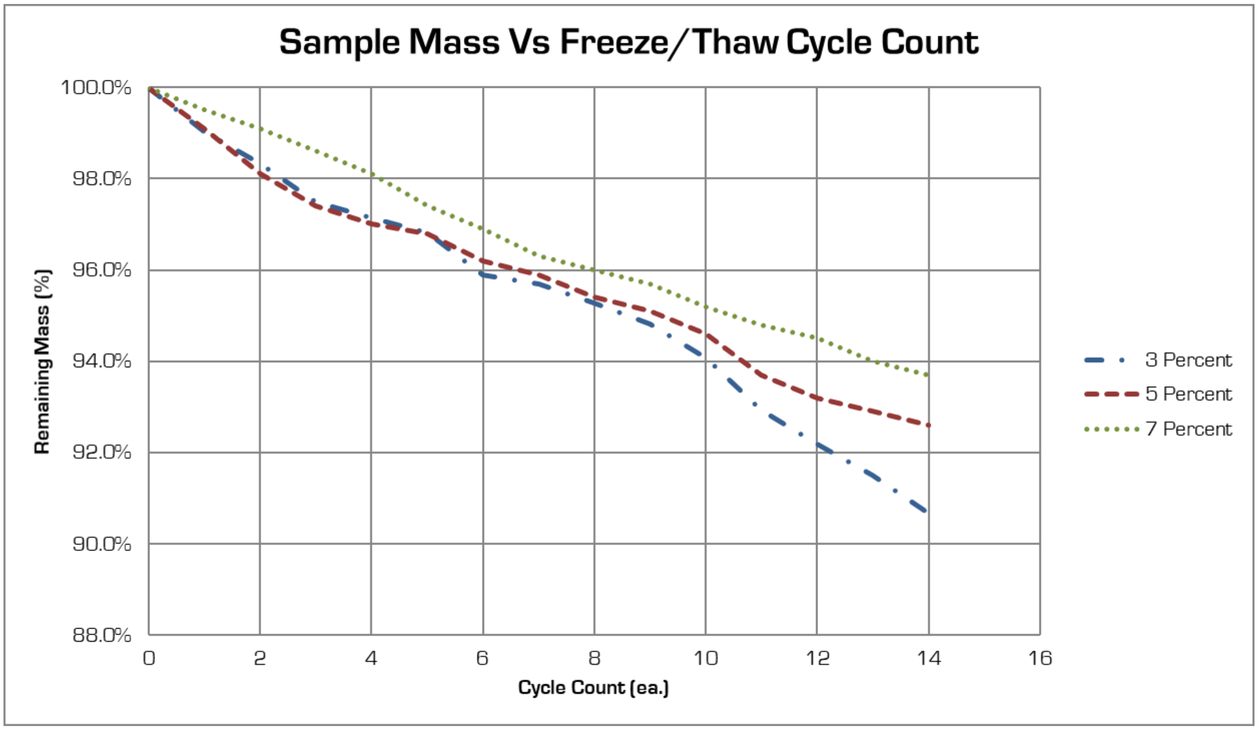
RESULTS

The results of the freeze thaw and abrasion testing are plotted in table 2 below. For the 3 percent additive sample, overall mass loss was 9.3 percent after 14 cycles which is less than the 14 percent allowable per typical industry specifications. The 5 and 7 percent samples exhibited less mass loss than the 3 percent as anticipated and outlined in table 2. Initial unconfined compressive strength and residual unconfined compressive strength are plotted in table 1. In all 3 application rates the residual strength was comparable to with slight strength loss in the 3 percent sample and slight strength increases in the 5 and 7 percent samples.

Table 1: Unconfined Compressive Strength Vs Application Rate

Application Rate (%)	Initial UCS (psi)	Final UCS (psi)
3	371	291
5	484	620
7	666	796

Table 1: Sample Mass Vs Freeze/Thaw Cycle Count



CONCLUSIONS

When applied as a stabilization additive to the idealized blend of 54 percent crushed limestone, 38 percent pulverized HMA and 8 percent sandy lean clay with silt, the additive blend sample MI-020-00001 was sufficient to render the material durable with regards to freeze/thaw cycling at 3 percent application rates and above. Additionally, it was sufficient to provide adequate internal strength for use in typical Full Depth Reclamation and/or soil stabilization applications and it retained that strength on par with other common additives.

Please don't hesitate to contact us if you have any questions regarding this memorandum.

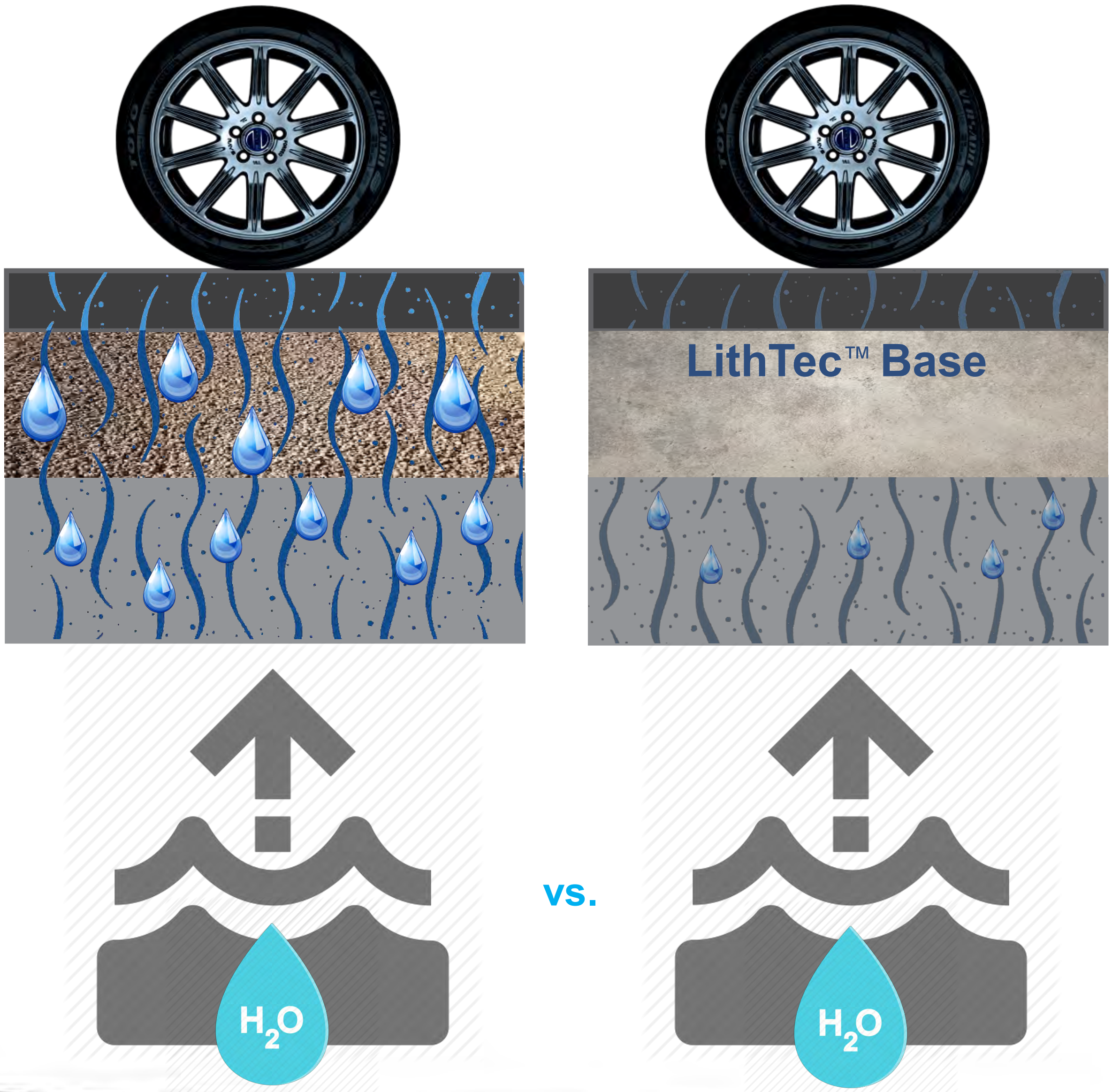
Sincerely,
Soils & Structures, Inc.

Don R. Dunkin, PE
Geotechnical Engineer

LithTec™ Advantage Freeze/Thaw

Traditional Granular Base is susceptible to high water tables, capillary action, and flooding. Water infiltration will result in poor performance under harsh freeze/thaw conditions.

A **LithTec™ Treated Base** reduces permeability, helps keep moisture out, remains bound, and reduces porosity resulting in excellent performance under freeze/thaw conditions.



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