IntegraSoil Technical Brief

April 2014

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1. Resperion Overview

Leading the way since 1999, Resperion is a global pioneer in the creation and development of innovative technologies and solutions for the road construction and infrastructure industries. Resperion manufactures the only asphalt modifier which so dramatically increases the structural capacity of asphalt that it is possible to reduce the thickness of base and binder courses and lower initial construction costs. Resperion also manufactures natural, environmentally-friendly products for dust control, soil stabilization, and cost-effective paving alternatives.

We understand that ever increasing performance requirements, energy optimization factors, and safety concerns, along with sustainable life-cycle needs, are creating new challenges and increased complexity for the road construction industry. Resperion, through our products, market knowledge, and extensive chemistry know-how, is a company that can help. We enable governmental agencies and private organizations to quickly and cost-effectively react to these market demands by bridging the gaps between traditional road construction methods and today's environmental and performance needs.

Through leveraging our innovative road construction and infrastructure products and expertise, these groups can save valuable time and money with their various construction projects. We also understand that regional and local factors such as raw materials, construction standards, climate, etc. are critical drivers in the construction marketplace, and have designed our products to meet the global needs of our customers.

Headquartered in Scottsdale, Arizona, Resperion is led by an experienced management and engineering team focused on delivering numerous solutions for road designers to build stronger, cost effective, longer lasting roads at a fraction of the cost of traditional materials.

2. Soil Chemistry Overview

Introduction

IntegraSoil is a multi-enzyme based soil stabilizer, which when applied to the appropriate soil and aggregates using the right construction techniques, can produce dramatic improvement on these materials.

Soil is not an inert material; in fact there are numerous chemical substances that will react with other chemical matter in the soil if certain conditions are present. These reactions result from the attraction of positive and negative charges in the components of the soil and the chemical substances. If something happened to alter these charges, the reactions are changed and furthermore the properties of the materials are changed. To better understand the stabilizing mechanism of IntegraSoil, the concepts of soil electrolyte systems, osmotic gradient pressure and colloid activity are introduced.

2.1 Soil Electrolyte Systems

Many subgrades, aggregates and mixtures of crushed rock and soils are known to behave as electrolyte systems where ion exchanges occur within the material. Knowledge of the layered lattice structure of clay materials, and of colloid transport and osmotic pressure gradients is critical in understanding the behavior of these electrolytes soils. Most clays have a molecular structure with a net negative charge. To maintain the electrical neutrality, cations (positively charged) are attracted to and held on the edges and surfaces of clay particles. These cations are called “exchangeable cations” because in most cases cations of one type may be exchange with cations of another type. When the cation charge in the clay structure is weak, the remaining negative charge attracts polarized water molecules, filling the spaces of the clays structure with ionized water.

2.2 Osmotic Pressure Gradients

Individual cations are unable to disperse freely in the soil structure because of the attractions of the negatively charged surface of the clay particles. This inability to disperse evenly throughout the solution creates an osmotic pressure gradient, which tries to equalize the cation concentration. As a consequence a movement of moisture from areas of low cation concentration to areas of high cation concentration is produced to achieve the equilibrium of the cation concentration.

2.3 Colloid Activity

Colloids are amorphous molecules without crystalline structures with a size of less than a micron. Particles of this size are strongly influenced by Brownian motion caused by random thermal motion. Colloids are present in high concentrations when clay soils are present. Colloids have a net negative charge that enables to attract and transport free cations in the soil electrolyte solution, subsequently losing the cation when passing close to the more strongly clay particle, leaving as a consequence the colloid free to seek more free cations. Both electrochemical and physical effects influence this mechanism.

The physical phenomena are related to Brownian motion, laminar shear velocity, and pore size distribution. Brownian motion overcomes the effects of gravitational force and prevents deposition, the laminar shear velocity affects the rate of cation exchange with

the clay structure and the pore size distribution determines the shear velocity and how close is the clay lattice to the passing colloids and cations.

The electrochemical effects are related to the attractions forces between positive and negative particles (Van der Waals forces), and to the repulsion forces between ions of the same charge. If a solution with cations is introduced into the clay structure, a microenvironment is created in which the cations are prevented from dispersing by their adjacent clay lattice. If the soil is not completely saturated, the liquid phase will move in laminar flow through the soil pores by capillary forces, leaving the higher concentration of cations close to the surface.

This creates an osmotic gradient pressure, which draws colloidal particles from zones of lower cation concentration. These colloidal particles take some of the free cations, reducing the ion concentration and the osmotic gradient pressure. This results in a hydraulic gradient pressure in the opposite directions which takes the cation transporting colloids outward from the original zone of cation concentration to another zone where another clay lattice is present, resulting in a new zone of osmotic pressure and cation concentration.

3. IntegraSoil Chemistry

3.1 Mechanism of the IntegraSoil Stabilizer

The flow of cations through the clay deposits gives the shrinking and swelling properties of the soils; when a stabilizer solution is added in to the soil, the magnitude of the effect depends on the characteristics of the particular cation. In general, there are two main characteristics: 1. the valence of the cation or number of positive charges and 2. the size of the cation.

The size determines the mobility of the cation: smaller ones will travel a greater distance throughout the soil structure (the hydrogen ion is the smallest one). With respect to the valence, the hydrogen ion is doubly effective affecting the clay structure because even though it has only a single charge, the hydrogen ion produces an effect of valence of two due to its high ionization energy. These hydrogen cations exert a stronger pull on the clay layers pulling the structure of the soil together and removing the trapped moisture permitted by the single sodium and potassium cations.

This loss of moisture results in a strengthening of the molecular structure of the clay and also in a reduction of the particle size and plasticity. Thus changes in the environment of the clay from a basic to acidic type of environment can result in the change of the molecular structure of the soil for a long period of time.

Organic cations created by the growth of vegetation also have the capacity to exchange charges with other ions in the clay lattice. Some of the organic cations are huge in size, equaling the size of the smaller clay particles. These larger organic cations can blanket an entire clay molecule, neutralizing its negative charges, and thus reducing its sensitivity to moisture. Soil bacteria make use of this process to stabilize their environment,

producing enzymes that catalyze the reactions between clays and organic cations to produce stable soil.

3.2 Stabilization Effects of IntegraSoil

IntegraSoil's formulation is adsorbed by the clay lattice, and then released upon exchange with metal cations. They have an important effect on the clay lattice, initially causing them to expand, and then to tighten. IntegraSoil can be also be absorbed by colloids - enabling them to be transported through the soil electrolyte media. IntegraSoil also helps the soil bacteria to release hydrogen ions, resulting in pH gradients at the surfaces of the clay particles, which assist in breaking up the structure of the clay.

IntegraSoil uses a multi-enzyme base. An enzyme by definition is an organic catalyst that speeds up a chemical reaction, that otherwise would happen at a slower rate without becoming a part of the end product.

The IntegraSoil multi-enzyme groups combine with the large organic molecules to form a reactant intermediary, which exchange ions with the clay structure, breaking down the lattice and causing the cover-up effect, which prevents further absorption of water and the loss of density. These enzymes are regenerated by the reaction and go on to react again. Because the ions are large, little osmotic migration takes place and a good mixing process is required. Compaction of aggregates near the optimum moisture content by construction equipment produces the desired high densities characteristic of shale. The resulting surface has the properties of durable "shale" produced in a fraction of the time (typically millions of years) required by nature.

When IntegraSoil is added to a soil, the multi-enzymes increase the wetting and bonding capacity of the soil particles. These enzymes allows soil materials to become more easily wet and more densely compacted. Also, it improves the chemical bonding that helps to fuse the soil particles together, creating a more permanent structure that is more resistant to weathering, wear and water penetration.

3.3 The Concept of Enzyme Stabilization & IntegraSoil

Enzyme stabilization is commonly demonstrated by termites and ants in Latin America, Africa and Asia. "Ant saliva", full of enzymes, is used to build soil structures which are rock hard and meters high. These structures are known to stand firm despite heavy tropical rain seasons.

IntegraSoil increases the wetting action, allowing for improved compaction of soil.
IntegraSoil cements the soil by forming weak ionic bonds between negative and positive ions present in the soil structure.
IntegraSoil can be used to stabilize a wide variety of soils. In addition, it results in a soil with a high resistance to frost heaving.

IntegraSoil is a natural organic compound derived from crop-plant biomass and is similar to proteins acting as a catalyst; the large molecular structures contain active sites that assist molecular bonding and interactions. IntegraSoil accelerates the cohesive bonding of soil particles and create a tight permanent layer. Unlike inorganic or petroleum based

products that have a temporary action, IntegraSoil creates a dense and permanent base and subgrade that resists water penetration, weathering and wear.

In normal road construction methods compaction levels in the range of 90-95 percent is usually obtained, while with IntegraSoil compaction densities of up to 100-105 percent may be reached. IntegraSoil soil stabilization can be applied to most soils, which contain a minimum of eight to eleven percent of cohesive fines.

The basic effects of the action of IntegraSoil into the structure of the soil can be summarized as follows. Initially, the film of absorbed water is greatly reduced and in fact entirely broken, as shown schematically in Figures 3.1 and 3.2.

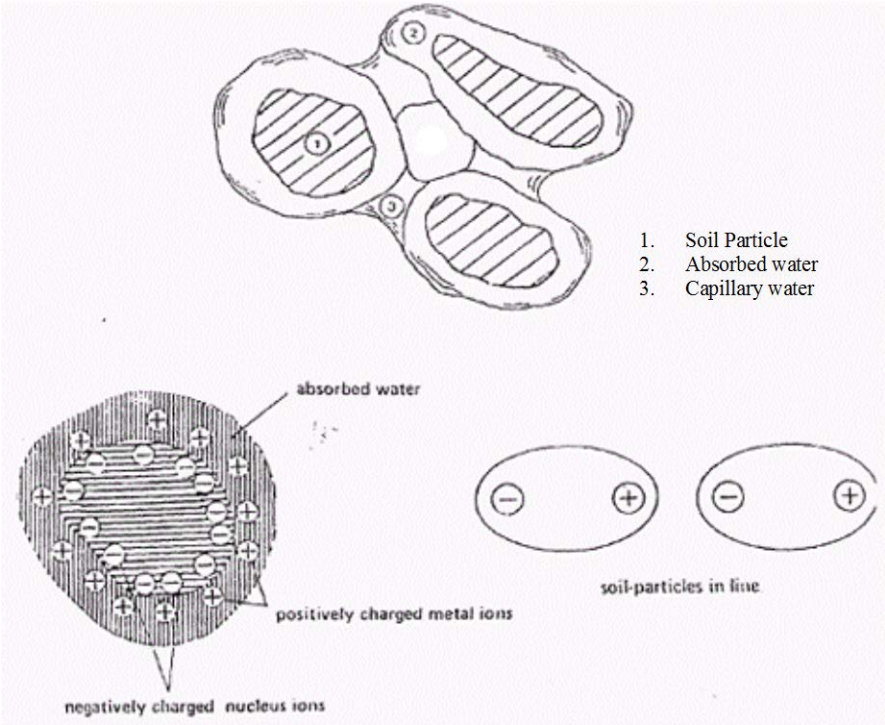

Figure 3.1 Absorbed Water in the Structure of the Soil [11].

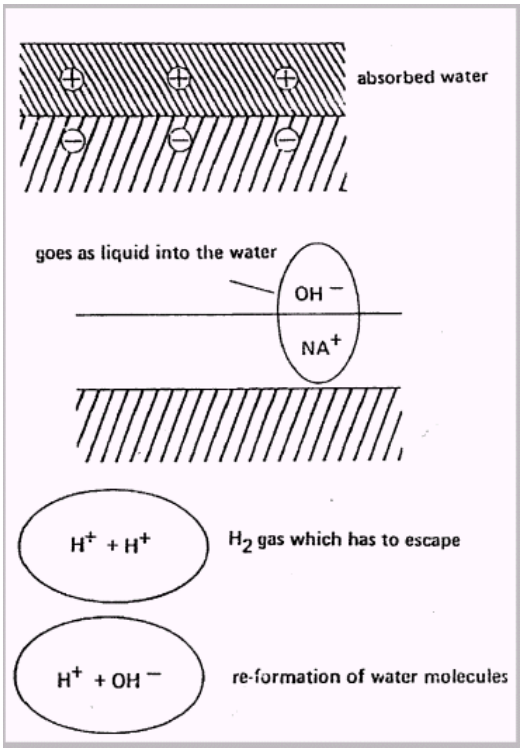

Figure 3.2 Elimination of the Absorbed Water in the Soil [11].

The most difficult problem is raised by the absorbed water in the soil that adheres to the entire surface of each soil particle. This film of water envelopes the particles and ultimately governs the expansion and shrinkage of colloidal soil constituents; this cannot be completely eliminated by purely mechanical methods. However, by means of temperature effects, addition or removal of water with mechanical pressure makes it possible to vary the amount of water held in this manner. Such variations are attended by swelling or shrinkage. This provides an ideal point of operation for IntegraSoil.

The electrostatic characteristics of soil particles also has to be considered to understand the mechanism of the soil-enzyme interaction. As a result of lowering the dipole moment of the water molecule by the enzyme, dissociation occurs in a hydroxyl (-) and a hydrogen (+) ion. The hydroxyl ion in turn dissociates into oxygen and hydrogen, while the hydrogen atom of the hydroxyl is transformed into a hydronium ion. The latter can accept or reject positive or negative charges, according to circumstances. Normally the finest colloidal particles of soil are negatively charged. The enveloping film of absorbed water contains a sufficient number of positive charged metal ions - such as sodium, potassium, aluminum and magnesium - which ensure charge equalization with respect to the electrically negative soil ion.

By bringing about this phenomenon, the positive charges of the hydronium ion or of the negatively charged hydroxyl ion will normally combine with the positively charged metal ions in the water, adhering to the surface of the particles. Because of the effect of the enzyme formulation in reducing the electric charge of the water molecule, there is sufficient negative charge to exert adequate pressure on the positively charged metal ions

in the absorbed water film. As a result, the existing electrostatic potential barrier is broken. When this reaction occurs, the metal ions migrate into the free water, which can be washed out or removed by evaporation. Thus the film of absorbed water enveloping the particles is reduced. The particles thereby lose their swelling capacity and the soil as a whole acquires a friable structure.

The hydrogen ions, which are liberated in the dissociation of the water molecules, can once again react with free hydroxyl ions and form water along the gaseous hydrogen. It is important to note that the moisture content of the soil affects the surface tension and is thus a factor affecting compaction. IntegraSoil reduces surface tension making the soil compaction easier to perform.

After the absorbed water is reduced the soil particles tend to agglomerate and as a result of the relative movement between particles, the surface area is reduced and less absorbed water can be held, which in turn reduces the swelling capacity.

3.4 IntegraSoil Stabilization Properties

- ***Increased compressive strength***: IntegraSoil acts as a catalyst to accelerate and strengthen road material bonding. IntegraSoil creates a denser, more cohesive and stable soil.
- ***Reduced compaction effort and improved soil workability***: IntegraSoil lubricates the soil particles. This makes the soil easier to grade and allows the compactor to achieve targeted soil density with fewer passes.
- ***Increased soil density***: IntegraSoil helps reduce voids between soil particles by altering electro-chemical attraction in soil particles and releasing bound water. The result is a tighter, dryer, denser road foundation.
- ***Lowered water permeability***: a tighter soil configuration reduces the migration of water that normally occurs in the voids between particles. IntagraSoil produces a greater resistance to water penetration deterioration.

3.5 IntegraSoil Benefits

- ***Environmentally safe***: IntagraSoil is made of enzymes, which are 100% natural, safe (organic) materials. These materials are non-toxic and will cause no harm or danger to humans, animals, fish or vegetation.
- ***Cost effective***: IntegraSoil holds up in all types of weather, resulting in low maintenance. Stabilization for the use of soil based roads can be achieved for a small fraction of bituminous paving or other resurfacing costs.
- ***Simple to use***: IntegraSoil is added to water, applied with a sprayer truck and mixed into the material. IntegraSoil comes in liquid concentrate. This benefit eases handling and preparation procedures and ads to the cost effectiveness.

4. IntegraSoil Handling

4.1 Storage

IntegraSoil's shelf life is 7+ years if it isn't diluted. If the product is mixed with water, it should be used within 72 hours. It is recommended that IntegraBase be stored in clean plastic containers for best storage results. If product is stored for extended periods of time, it is recommended that the liquid is agitated before use as some settling of solids can occur over time.

4.2 Safety

Integrasoil contains no harmful chemicals, and has no special handling requirements. Everything contained in IntegraSoil is registered and approved for use by the EPA and OSHA. All information concerning safety can be found in the IntegraSoil Material Safety Data Sheet (MSDS – appendix A.)

4.3 Transport Options

There are no transport restrictions when shipping IntegraSoil. IntegraSoil can be shipped by air, land and sea; there are many options for the actual storage of the product including, drums, totes, bladders, etc. Storage options are usually dependent on the size of the project – the smallest jobs can be served by 55-gallon drums while the largest projects are best served by rubberized bladders placed in 20/40-foot containers.

5. Lab Testing of IntegraSoil

5.1 Procedures

IntegraSoil chemical reactions entail multiple enzyme reactions, it is important to make sure that a proper mix of product and soil are prepared so that the enzyme reactions can be completed. Typically a sample of 16oz. of IntegraSoil should be sufficient for a full battery of tests.

5.2 Step-by-Step Process

1. Prepare soil by weight for test.
2. Calculate water to add to achieve Optimal Moisture for Compaction.
3. Shake IntegraSoil product VERY well since solids will need to be well mixed.
4. Calculate the amount of IntegraSoil to be used (see below for ratio)
5. Add IntegraSoil to water and mix. Pour water as normal and mix soil as normal.
6. Put in molds and compact as normal.
7. Put molds aside and let cure for 5-7 days (dry test) or 12-15 days (wet test)*.
8. Break molds and calculate as normal.

IntegraSoil Application Ratio:

1 liter of IntegraSoil to 15 cubic meters of soil.

**Please note: IntegraSoil is an enzyme that requires reaction time with the soil. The chemical reaction happens over time, with a majority of the reaction taking place in the first 72 hours (IntegraSoil roads can be opened up for traffic in 24 hours).*

6. IntegraSoil Application Specification

6.1 General

The completed course shall be uniformly treated, free from loose rock or segregated areas, of uniform density and moisture content, for its full depth and shall have a smooth surface.

6.2 Moisture Tolerance

After pulverization is complete and prior to application of the IntegraSoil stabilizer treatment, the moisture contentof the base or subbase material may not be more than five (5) percentage points below and not greater than the optimum moisture content determined for the treated material (the optimum moisture content as determined for bases and subbase materials treated with the liquid stabilizer solution by Test Method ASTM D-1557). Moisture content should be checked at several locations in each section to be treated to ensure that the moisture content of the material is within tolerance throughout the length and width of the section. Materials that are drier than moisture content tolerances should be moisture conditioned by sprinkling with additional water to secure uniform moisture content throughout the layer that is within the required tolerances. Materials that are wetter than moisture content tolerances should be allowed to dry back through natural drying or aerated during suitable weather conditions with mixing equipment such as motor graders, tractor drawn disks or cross-shaft rotary mixers. Aeration by compaction equipment, such as a Sheepsfoot roller, will not be permitted.

6.3 Application Rate

The application rate of IntegraSoil soil stabilizer treatment shall be one (1) gallon per one hundred thirty (130) cubic yards of raw subgrade/aggregate material. The tolerance from the specified application rate shall be plus or minus ten (10) percent. However, if laboratory tests show continued increase in strength from higher levels of application, additional product can be added at the desired application rate, not to exceed five (five) times the standard application rate of one (1) gallon per one hundred thirty (130) cubic yards of raw subgrade/aggregate material.

6.4 Dilution Ratios

There is no predetermined, required rate of dilution for the IntegraSoil soil stabilizer treatment. The dilution ratio for IntegraSoil stabilizer treatment is instead determined by the volume of subgrade/aggregate materials that is to be treated. The IntegraSoil soil stabilizer treatment is to be added at the rate of one (1) gallon per one hundred thirty (130) cubic yards of soil, irrespective of the volume of water required to bring the materials within not less than two (2) percentage points below or not greater than two (2) percentage points above the optimum moisture content determined for the treated material (the optimum moisture content as determined for bases and subbase materials treated with the liquid stabilizer solution by Test Method ASTM D-1557). However, after pulverization is complete and prior to application of the IntegraSoil stabilizer treatment, the moisture content of the base or subbase material may not be more than five (5) percentage points below and not greater than the optimum moisture content determined for the treated material (the optimum moisture content as determined for bases and

subbase materials treated with the liquid stabilizer solution by Test Method ASTM D-1557).

6.5 Dilution Procedures
All of the dilution water (100%) required to bring a given volume of subgrade/aggregate material within not less than two (2) percentage points below or not greater than two (2) percentage points above the optimum moisture content determined for the treated material shall first be added to the mixing tank before the IntegraSoil soil stabilizer solution is added at the rate of (1) gallon per one hundred thirty (130) cubic yards of raw subgrade/aggregate material. After the addition of IntegraSoil soil stabilizer treatment to the dilution water, some further mixing will be required to prepare the stabilizer solution for application.

6.6 Applications Preparations
Unless otherwise approved by the Contracting Officer's representative, the treated subgrade/aggregate material shall be constructed in successive layers for the full width of the individual roadway cross section and in such lengths as are best suited to the stabilizer application and compacting methods utilized. The Contractor shall prepare a written summary, for the Contracting Officer's representative's review, before stabilizer treatment of each section to be treated. The following information should be included:

- In situ moisture content of the subgrade/aggregate material of each section to be treated and the treated optimum moisture content for this material.
- Liquid volume capacity and planned fill level for all spreader or water trucks and other equipment that will be used to transport, spread or otherwise distribute the stabilizer solution.
- Cubic yardage of subgrade/aggregate material to be treated for each section of the project.
- Calculated quantity of liquid stabilizer required for the cubic yardage of subgrade/aggregate material to be treated for each section.
- Calculated quantity of stabilizer solution (the total gallons of liquid stabilizer plus the total gallons of dilution water) required for each section to be treated.

6.7 Application
Application of the stabilizer solution shall be limited to the area specifically shaped and sized to receive the treatment and shall be limited to a section of such an area such that all operations including mixing, compaction and grading are continuous and completed the same day. If overnight temperatures are not expected to drop below 32° F, it shall be the Contracting Officer's representative's option to allow treated material to remain in a stockpile or windrow overnight with the requirement that moisture content must be checked and properly adjusted within moisture tolerances for compaction when construction operations resume the following day.

- Unless otherwise approved by the Contracting Officer's representative, stabilizer treatment shall not be started when the air temperature is below 40° F and falling,

but may be started when the air temperature is above 35° F and rising. The stabilizer solution shall not be applied during periods of rainfall. If rainfall is encountered during application of the stabilizer solution and excessive loss of solution occurs, the Contractor shall, at his expense, reapply the stabilizer solution to the affected area at a rate of one-half (½) of the original application rate. The Contractor shall then re-mix and compact the material to the same specifications of the original application.

- During rapid drying conditions, five (5) percent of the stabilizer solution shall be retained and sprinkled on surface materials during final compaction and/or final grading operations to protect the materials from desiccation and segregation while still being worked.
- Lifts greater than eight (8) inches not to exceed twelve (12) inches will be permitted only with the approval of the Contracting Officer's representative. The Contractor shall, at his own expense, demonstrate the ability to provide not less than 95 percent of the optimum density as determined by Test Method ASTM D-1557 while working within the requirements of this specification.
- The stabilizer solution shall be distributed and applied at a uniform rate and in such a manner that the entire surface area is covered with the solution after visual inspection. If untreated areas are found after inspection, the Contractor may hand apply the stabilizer solution to the untreated areas to achieve full coverage. If the spray pattern is not uniform and failure to achieve full coverage occurs on a repetitive basis, then the Contractor will be required to remix the material by methods acceptable to the Contracting Officer's representative to achieve a homogeneously moisturized treated material. To prevent excessive application of stabilizer solution and moisture build up, the overlap of each pass shall not exceed twelve (12) inches.
- The Contractor shall take precautions when application occurs on unleveled or sloping terrain or in any situation, such as channelization or rutting of the base or subbase materials by the construction equipment, where the stabilizer solution flows and travels away from the area where it was applied. If during application of the stabilizer solution runoff results in loss of the stabilizer solution from the area to be treated or in excessive puddling, then modifications to the application procedure must be made immediately. The Contractor will be required to make an additional application and/or mixing passes in which a reduced quantity of stabilizer solution is applied with each application and/or mixing pass that results in applying the total amount specified without excessive runoff and puddling. Any other method of correction that does not rely on additional application and/r mixing passes must first be demonstrated to the satisfaction of the Contracting Officer's representative.

6.8 Mixing

The subgrade/aggregate material and the stabilizer solution shall be thoroughly mixed by a tractor drawn agricultural disc with depth gang wheel as the primary mixing unit. A cross-shaft rotary mixer may be used for additional mixing. Subject to approval of the Contracting Officer's representative, a motor grader, or other suitable instrument, may

also be used as a mixing unit. The mixing shall continue until the treated material reaches a homogeneous mixture with a moisture content within specified compaction moisture tolerances as described above.

- Natural weather conditions that increase the moisture content beyond specified tolerance, and prior to full and complete compaction, will require re-mixing and air-drying to reduce the moisture content of the base or subbase material. Natural weather conditions that decrease moisture content below specified tolerance, and prior to full and complete compaction, will require moisture conditioning by sprinkling with additional water. Prior to compacting the treated material, the moisture content of the material shall be within specified tolerances for compaction as described above.
- The operations of stabilizer application, mixing, compacting and finishing should be continuous. If the compacted lift is to be finished by milling or planing equipment, finishing may be completed at a later date as long as the surface is kept damp during the interim period.
- If the stabilizer solution is applied at a rate which exceeds the absorbency of the loosened subgrade/aggregate material, and ponding, or runoff and flow from the treated area is observed, then adjustments to construction operations should be made immediately.

6.9 Compaction Methods

Prior to compaction, the Contractor shall aerate or sprinkle and test the treated subgrade/aggregate material as necessary to provide a moisture content not more than three (3) percentage points above and not less than the optimum moisture content for the treated material (as determined by Test Method ASTM D-1557) or unless otherwise approved by the Contracting Officer's representative. Aeration by compaction equipment, such as a sheepsfoot roller, will not be permitted. Compaction of the treated subgrade/aggregate mixture shall begin immediately after the mixing, pulverization and compaction moisture content requirements are met.

- Sheepsfoot rollers should be utilized for initial compaction operations, accompanied by other types of compaction equipment as necessary. The sheepsfoot rollers should be operated in continuous passes over all treated areas until they "walk out" of the treated material leaving only minimal indentations in the surface. Grades should be left adequately high and compaction operations conducted so that the final grade is achieved by shaving and trimming with a motor grader to a hard uniform surface. All material removed should be bladed to the edge of the stabilized area and wasted.
- Each layer shall be compacted uniformly to the extent necessary to provide not less than 95 percent of the optimum density as determined by Test Method ASTM D-1557. Field density determination will be made in accordance with Test Method ASTM D-2922. Throughout the compaction operation the shape of the compaction layer shall be kept leveled with suitable equipment to ensure uniform compaction over the entire layer. If the treated materials, due to any reason or

cause, lose the required stability, density or finish before the next course is placed or the project is accepted, the affected area shall be reworked as specified below.

6.10 Reworking a Section

When a section is reworked after application of the stabilizer treatment and within 24 hours after completion of compaction, the Contractor shall rework the section to provide the required compaction. After the 24-hour period following the completion of compaction, the section requiring rework shall be maintained at or above its optimum moisture content until the reworking operation begins. When a section is reworked 24 hours after completion of compaction, which has been allowed to dry back below its optimum and cure to a dry and hardened state, then the Contractor shall reapply the stabilizer solution at a rate of one-half (½) of the original application rate to the affected area and remix and compact the material to the same specifications of the original application. When a section is reworked, a new optimum density will be determined from the reworked material in accordance with Test Method ASTM D-1557. Rework of treated materials shall be at the expense of the Contractor.

6.11 Finishing and Curing

After the final layer or course of the material has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by seal rolling with a pneumatic tire or other suitable roller approved by the Contracting Officer's representative and allowed to cure for forty-eight (48) hours before traffic is permitted. When approved by the Contracting Officer's representative, traffic may be allowed back on the treated subgrade/aggregate surface after no less than forty-eight (48) hours of curing; but the contractor will be responsible for repair of any rutting or damage that occurs while the material is curing.

7. Tolerances

7.1 Tolerances shall conform to the following:

Thickness Tolerances of Treated Subgrade/Aggregate Courses: At no time during the mixing process shall the Contractor increase or decrease the depth of the treated subgrade/aggregate course section as detailed on the plans without the approval of the Contracting Officer's representative. If any deviation should occur, that section shall be reworked according to construction operations and testing described above.

8. Overlay Design

8.1 Overlay Guidelines

When implementing an IntegraSoil subbase, an overlay can be utilized and should be designed with characteristics such as friction, smoothness, noise control, and drainage in mind. Often, rut resistance is something that is designed into the surface course, but when using Integrasoil, the base or binder course provides the rut resistance. In addition, the overlay should prevent the entrance of surface water into the underlying base, subbase

and subgrade. Resperion recommends using a flexible wear course, and not using it for a load carrying member of the pavement design.

IntegraBase base or binder courses can be used with any wear course. As long as the overlay can seal off the IntegraSoil treated soil, and provide adequate friction and drainage, there should be no problems with the overlay.

Depending on the traffic and loads, the most ideal overlay is a seal (chip, fog, slurry, etc.) as these provide drainage and friction, and will not rut. However, these types of overlays are not ideal for many different designs or implementations. Here are two surface courses that Resperion recommends for different climates:

Polymer caps can also be used to seal off IntegraSoil treated soil – they typically don't last very long, but can extend the life of the road by a year or more.

MATERIAL SAFETY DATA SHEET - IntegraSoil

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Revision Date	January, 2014
Product Name	IntegraSoil
Product Identification Number(s)	N/A
Manufacturer/Supplier	Resperion LLC, Scottsdale, AZ 85255
Chemical Name	N/A
Synonyms(s)	N/A
Molecular Formula	N/A
Product Use	Soil Stabilization
OSHA Status	Nonhazardous
Physical State	Liquid

2. HAZARDOUS INGRIDIENTS

Hazardous Ingredients	None

3. FIRE AND EXPLOSION HAZARDS

Flash Point	N/A
Upper Flammable Limit	N/A
Lower Flammable Limit	N/A
Extinguishing Media	N/A
Special Firefighting Procedures	None
Unusual Fire & Explosion Hazards	None

4. HEALTH HAZARD DATA

Oral Toxicity	None
Eye Irritation	Not expected to cause eye irritation
Skin Irritation	Overexposure can cause drying of the skin and dermatitis in sensitive individuals.
Other	Unknown

5. EMERGENCY FIRST AID PROCEDURES

Skin	Skin should be flushed with water
Eye	Irrigate with water for 15 minutes
Inhalation	N/A – aqueous solution
Oral	Give water to dilute & call a physician
Notes to Physician	Very low toxicity. LD50>5g dry matter/kg (rat, oral)

6. SPECIAL PROTECTION INFORMATION

Ventilation Procedure	Adequate ventilation for comfort recommended
Gloves Protection	Gloves recommended for prolonged exposure
Eye Protection	Goggles recommended for prolonged exposure
Other Protection	Clothing which contacts skin should be changed daily

7. PHYSICAL DATA

Vapor Pressure (mm Hg)	760@ 100°C (Water)
Specific Gravity	1.0 (water)

Water Solubility	Emulsifiable
Percent Volatile by Weight	Minus 44 (Water)
Vapor Density (Air = 1)	Water
Evaporation Rate (Butyl Acetate=1)	.1
Odor	Mild
Appearance	Brown Turbid Liquid

8. STABILITY

Stability	Stable
Incompatibility	None
Polymerization	Will not occur
Hazardous Decomposition Products	Carbon Monoxide

9. SPILL OR LEAK PROCEDURES

Spill Procedures	Mechanically collect and remove spilled material. Area may be washed with water. No neutralizing chemicals needed.
Waste Disposal	According to local, state and federal regulations.

10. SPECIAL PRECAUTIONS

Special Precautions	Do not mix with other chemicals, Oxiders, e.g. Bleach

11. TRANSPORTATION AND LABELING

Emergency Action Code	Non-Hazardous for transport purposes
HMIS Rating (0-4)	Health=1, Fire=0, Reactivity=0, Special=0
Hazard Class – DOT	Not Restricted
Hazard Class – IATA	Not Restricted

UN G 4 compliant and ORM. Non-hazardous, non-toxic, non-caustic, totally safe, fully biodegradable

12. OTHER INFORMATION

For other information, please contact Resperion at:

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